FLUKE AND PHILIPS - THE GLOBAL ALLIANCE IN TEST & MEASUREMENT

FLUKE **PHILIPS**

Oscilloscopes
Multimeters & Voltmeters
Logic Analyzers
Board Testers & Troubleshooters
Calibrators & Standards
Signal Sources
Counters/Timers
Instrumentation Systems
Data Acquisition
Operator Interfaces
Digital Thermometers
Recorders & Plotters
Software
Instrument Accessories
Customer Support Services

Test & Measurement Catalog

1989

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How to use this catalog

The section numbers listed in the above table of contents outline the broad product groupings you will find in this catalog. You can reference each of these sections by simply thumbing to the appropriate number shown on the outer margin of each product page.

When looking for a specific product or type of product within each product section, first refer to the divider page for the section. Here you will find a handy table of contents, along with pictures of several key products featured in that section. Directly following most divider pages is a selection guide that compares key features and specifications of all products in the section, and lists page numbers.

The front of the catalog also includes three master-reference page indexes. One is an alphabetized functional listing of all products and services in the catalog, the other two are numerical listings for both the Fluke and Philips product lines.

When you have found the product you want, you may request more information by filling out and returning the enclosed reply card, or by directly contacting your nearest Fluke or Philips office as listed in the last section of this catalog.

Fluke World Headquarters Everett, Washington, USA.

Philips Research Laboratories, Eindhoven, the Netherlands.

THE GLOBAL ALLIANCE: THE NEW WORLD OF TEST AND MEASUREMENT

The Fluke and Philips test and measurement alliance is now one year old, and customers around the world are already experiencing the benefits of this unique cooperation. This catalog reflects our newly expanded product and service offerings. It includes complete specifications and performance characteristics of the entire Fluke and Philips line – over 650 products and services in all. Several new product offerings are featured for 1989, and a full-color overview of each appears in the following pages of this section.

Our Alliance -- Your Benefits

A corporate commitment to engineering excellence and a sizable investment in R&D by both Fluke and Philips allow us to design advanced technology into our products. For example, more and more of our products now exploit the increasing power of the PC, giving you more performance and efficiency from your test instrumentation. We have also expanded our product line to include support for the latest types of microprocessor-based circuitry, including the 80386. And a new generation of key product families combine the performance and functions of several instruments for easier, faster, and more capable testing of today's complex electronics circuitry.

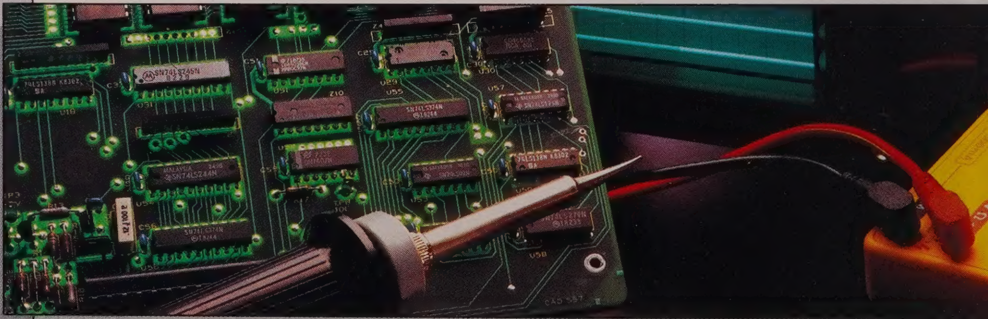
But the Fluke and Philips alliance is more than just products. It is a strict obligation to your complete satisfaction, evidenced by the people, parts, and facilities dedicated to serving and supporting your T&M needs over a wide range of industries and applications. This is what you can count on with every Fluke and Philips product you purchase.

We invite you to examine our products closely, and compare them to any you are currently using or considering. We are confident that Fluke and Philips products can meet or exceed your performance requirements, while keeping your cost of ownership low.

We hope you enjoy our 1989 catalog.

Research & Development

Manufacturing

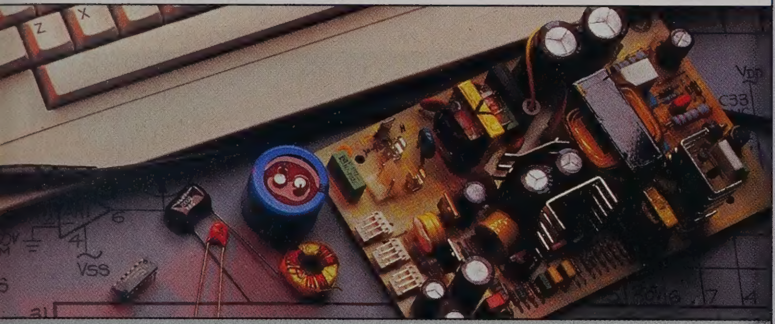


Service

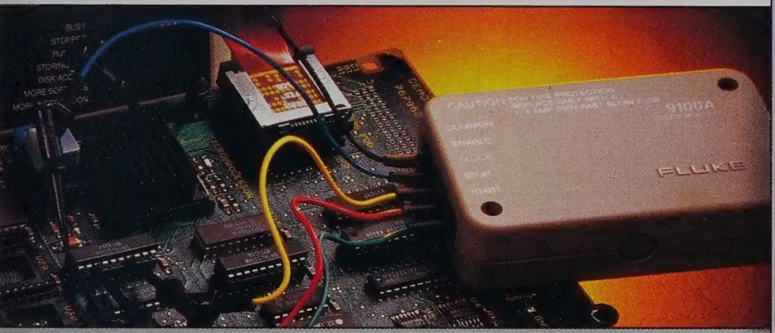
FLUKE
Report of Calibration
John Fluke Mfg. Co., Inc.
5440B DIRECT VOLTS CALIBRATOR
JOHN FLUKE MFG. CO., INC.
METROLOGY SYSTEMS
SEAL OF CERTIFIED CALIBRATION
WASHINGTON
Example of Cal Results→PC Output

Calibration

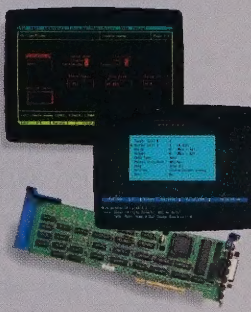
A few highlights of this year's new products



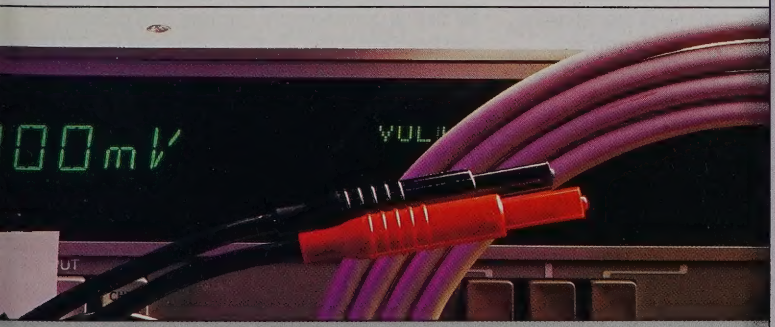
As circuitry becomes faster, so must T&M instruments - and the new PM 3340 digitizing oscilloscope uses a sequential sampling system that combines a wide 2 GHz bandwidth with unmatched 1mV sensitivity and full 2 GHz triggering. The new PM 3655 is a low-cost logic analyzer that delivers exactly what it promises. Unlike many similar instruments, its 96 channels, 100 MHz bandwidth, 2k memory/channel and 5ns glitch capture are always available in any configuration.



Two new software packages for the PC (Screen Builder and Icon Builder) provide a simple, standard method to ease generation of custom screens and diagrams for the 1030 and 1050 Series Touch Control Screens. And there are several new software packages for GPIB/IEEE systems as well.
The TestTeam Software greatly speeds test program generation for PC-based IEEE instrumentation systems. Also, a new interface card allows the IBM PS/2 to control automatic test sequences.
And a range of dedicated instrument drivers for many Fluke and Philips instruments greatly reduces your systems programming efforts.



The new 80 Series is one of the most notable multimeter introductions of the decade, offering more measurement functions and special features than ever before in a splash-proof and dust-proof handheld package. Also ideal for many service applications is the new PM 3308 scope.
It is a 100 MHz portable scope with innovations such as a flat, flicker-free electroluminescent screen and a 180 kByte RAM disk - in a lightweight, rugged portable package.



The 5700A Multifunction Calibrator handles the broadest workload of any calibrator and offers excellent DC and AC accuracy. Only three Artifact standards and about one hour are enough to set it up to maintain its accuracy and traceability to legal standards. We further extend the comprehensive range of calibration offerings with the 7411 PC software, which allows a PC to control an automated calibration system - even keeping calibration records for you.

Complete new products preview on following pages.

New Products

NEW

PM 3365 100 MHz, 100 MS/s Digital Storage Oscilloscope

- High performance analog and digital scope
- High 100 MS/s sampling rate on each channel simultaneously
- Full 100 MHz bandwidth
- 2 mV sensitivity
- Triggering to 150 MHz
- Multifunction AUTOSET gives instant display of signals
- Advanced automatic measurements
- Delayed Time Referencing
- Reference memories
- RS 232 and IEEE-488 interface options

The PM 3365 is the best in 100 MHz analog *and* digital performance. Full 100 MHz analog performance includes Autoset for instant display of a waveform in just 2 seconds. For single shots, the 100 Ms/s 8-bit converters on each channel reveal the smallest and fastest transient and also digitize repetitive signals extremely quickly over the full 100 MHz bandwidth in the equivalent time DSO mode. To zoom in on details, the Delayed Time Referencing mode offers the digital equivalent of delayed time base mode in an analog scope. Extensive cursor facilities and math functions allow direct measurements, and reference memories are available for signal comparisons. IEEE-488 and RS 232 interfaces are available for hard copy devices such as printers and plotters, and for full remote control.

See page 43 for full description

NEW

PM 3340 2 GHz Digitizing Oscilloscope

- DC to 2 GHz bandwidth
- 175 ps risetime
- Trigger response up to 2 GHz
- Four 4 kbyte × 10-bit memories
- 1 mV/div vertical sensitivity
- Powerful automatic measurements and signal processing functions
- Eye pattern and constellation diagrams for PCM inspection
- Autoset selects settings for instant on-screen display
- Probes operating over full bandwidth
- IEEE-488 and RS 232 interfaces

The PM 3340 sets new standards in acquisition, display and analysis of ultra high frequency signals. A full 2 GHz bandwidth and 175 ps risetime ensures accurate reproduction of the fastest edges. Triggering over the full bandwidth is standard and the many trigger modes cover most applications. 10-bit vertical resolution ensures every signal detail is visible. Extensive cursor measurement capabilities and math functions give accurate processed results "on-line". Up to 12 k sample points can be displayed on screen which, combined with the measurement functions, makes the PM 3340 ideal for PCM eye pattern or constellation measurement. It is as easy to use as standard analog instruments and, for systems use, has RS 232 and IEEE-488 interfaces included as standard.

See page 26 for full description

NEW

PM 3335 20 Ms/s, 50 MHz Advanced Digital Storage Oscilloscope

- Dual Analog and Digital Storage
- 50 MHz real time analog bandwidth
- Deep 8 KBytes × 8-bit waveform acquisition memory
- Second reference memory for comparison of waveforms
- AUTOSET for instant on-screen trace display
- Standard cursors for on-screen measurement functions

All the power and facilities of analog and digital scopes are combined in this economical scope. Repetitive signals up to 50 MHz can be analyzed in analog mode and for single shot work, both channels have a fast 20 Ms/s 8-bit convertor. Autoset automatically gives optimal display of the input signal. With 8 kbytes memory depth per channel, extensive pretrigger information is available. Screen cursors enable time and amplitude measurements and reference memories are available for signal comparison. Printers and plotters can be connected via the combined RS 232/IEEE-488 interface, which can also be used for remote control of the instrument and measurement transfer in small systems applications.

See page 47 for full description

NEW

PM 3320A 200 MHz, 250 Ms/s Advanced Digital Storage Oscilloscope

- Maximum bandwidth of 200 MHz
- 250 Msamples/s per channel
- 4 ns realtime resolution per channel, single shots
- 10 bit vertical resolution
- Horizontal expansion up to 128 times
- Extensive cursor and math facilities
- IEEE-488 and RS 232 Interface

The Philips PM 3320A is a digital storage oscilloscope which offers a combination of high resolution signal digitizing and analysis and an easy to use front panel with softkey operation. The softkeys allow direct access to the most frequently used controls which, together with the clear panel and screen layout, make the instrument easy to use and encourages the user to make full use of its functions. The PM 3320A's features include a very fast sampling speed of 250 Msamples/s per channel; storage of traces and set-up parameters; and pre- and post-triggering allowing long time interval waveforms to be captured and analyzed in detail. Cursor measurement facilities and math functions enable extensive post processing of captured data, including even optional FFT analysis of measured signals. The PM 3320A is fully IEEE-488 and RS 232 Compatible.

See page 31 for full description

NEW

PM 3308 40 MS/s Compact Digital Storage Oscilloscope

- 100 MHz bandwidth
- 40 Ms/s maximum sample rate
- Autoset for instant on-screen trace display
- Deep 8 kBytes acquisition memory
- 180 kBytes non-volatile RAM disk
- 22 cursor measurement functions
- Powerful math processing
- Large flat electroluminescent display

The Philips PM 3308 digital storage oscilloscope offers a combination of high performance and features in a small package. A flat electroluminescent display gives very sharp, clear waveform display over a wide 140° viewing angle and it can be folded flat to give a very compact, portable package. It includes a 180 kBytes non-volatile RAM disk for storage of up to 100 traces, set-ups, or a combination of both. Powerful signal processing facilities include addition, subtraction, integration and differentiation, and extensive cursor measurement capability is also provided. The PM 3308 is completely programmable within a system environment through its IEEE-488 and RS 232 interfaces, included as standard.

Available Mid 1989

See page 37 for full description

NEW

80 Series Analog/Digital Multimeters

- Min Max Average recording mode with MIN Max Alert™
- Frequency, duty cycle and capacitance measurements
- 1000V input protection; Input Alert™ detects wrong input jack connections
- 3¾ digit, 4000 count display updates 4 times per second; analog display updates 40 times per second
- 4½ digit mode, 1 ms peak hold, back lit display and true RMS measurements (87 only)
- Touch Hold® and Relative modes
- Splash proof and dust proof case; EMI shielded
- Protective holster with Flex-Stand™
- Safety-designed test lead set

The new Fluke 80 Series (83, 85 and 87) are high performance meters with 11 functions and 40 ranges for a wide variety of electronic and industrial applications. They offer an impressive range of capabilities, including frequency, duty cycle and capacitance measurement, and feature durable construction and several unique safety features. For changing or unstable signals, the 87 features a high-resolution analog pointer, the 83 and 85 use an analog bargraph. The 83 and 85 also feature a Zoom Mode for higher resolution analog readings. Basic dc accuracy on the 83 is 0.3% of reading, the 85 and 87 feature 0.1% basic dc accuracy.

See page 110 for full description

New Products

NEW PM 3655 Low-Cost 100 MHz 96 Channel Logic Anlayzer

- Full 100 MHz sampling speed on up to 96 channels for timing and state analysis
- 2 kbytes memory always available on all 96 channels
- 5 ns glitch capture on all channels, at full 100 MHz and with full 2 kbytes memory
- Sophisticated multi-level triggering and 4 clock qualifiers
- High quality, low impedance probes
- Simple, familiar operation
- Plus full MS-DOS-based PC

PM 3655 offers no-compromise performance at low cost. Unlike some other instruments in its class, all functions can be used at full rated spec at all times, regardless of which combination of features are in use. Sampling speed is 100 MHz on all of its maximum 96 channels. Each channel always has 2 kbytes memory available and glitch capture can capture transients down to 5 ns, still at full speed and with all the memory. State and time analyses, or combinations, are possible through the many powerful triggering functions. This performance is available in configurable modules of 24-channels each, so you can have the power matched to your needs and budget. Plus, the logic analyzer has the familiar functionality of a PC, (with menu operation, for example), for superior ease-of-use, and it operates separately as a PC, running common software packages. RS 232, Centronics and IEEE-488 interfaces are standard.

See page 153 for full description

NEW 9132A Memory Interface Pod

- Support for 32-bit designs
- Fluke's new HyperTEST™ RAM test algorithm
- Advanced diagnostic capability for isolating bus faults
- Quick memory test

The 9100A Digital Test System from Fluke now supports advanced 32-bit designs (like the 80386 and 68020) with the new 9132A Memory Interface Pod. The pod can be adapted quickly and inexpensively to accommodate future microprocessor support needs with only a microprocessor-specific personality module and software disk.

The 9132A connects to the 9100A mainframe in the same way as other Fluke pods to stimulate and test UUT circuitry, but uses a new pod technology. Connection is made through a sync module and by replacing the UUT boot ROMs with ROM modules. The 9132A accesses and controls the UUT's microprocessor through the boot ROM sockets. Instructions are passed through the ROM modules stepping the UUT microprocessor through various built-in and user-written tests. Similar to the user interface for other Fluke pods, the 9132A can be controlled through commands written in high-level language, rather than requiring the user to generate microprocessor-specific assembly code.

See page 172 for full description

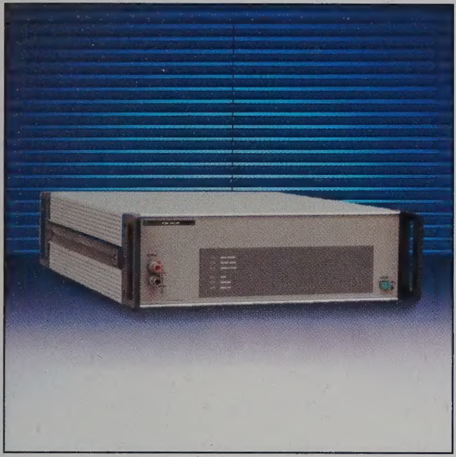
NEW 5700A Calibrator

- Covers the complete DMM calibrator workload
- Precision performance that is easy to use
- Simplified support with Artifact Calibration
- Compatible to protect your investment

The new 5700A Calibrator is designed to deliver outstanding performance while minimizing the costs associated with supporting and using a high-accuracy instrument.
Only three Artifact Standards are required to perform periodic calibration of all 5700A ranges and functions. And internal references and the unique Cal Check feature make it convenient to verify performance between calibrations. Full, independent verification of the 5700A is extended to two years.
The 5700A is designed to calibrate the broadest cross section of your meter workload. It delivers direct voltage to 1100V and alternating voltage from 200 μV to 1100V at frequencies from 10 Hz to 1.2 MHz. Cardinal point resistances range from 1 Ω to 100MΩ in x1 and x1.9 decades, including a short. Alternating and direct current are provided to 2.2A, and frequencies for alternating current range from 10 Hz to 10 kHz. The wideband voltage option extends alternating voltage frequences from 10 Hz to 30 MHz.

See page 187 for full description

NEW 5725A Amplifier

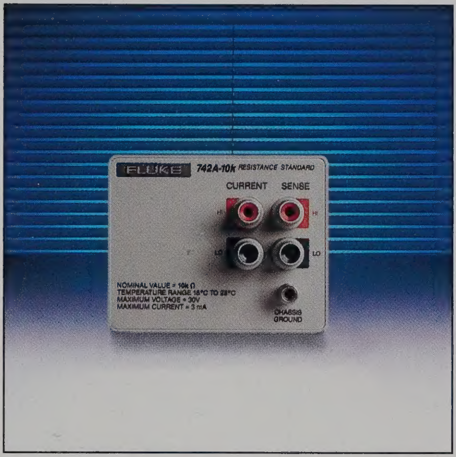


- Companion to the 5700A calibrator
- Extends current and Volt-Hertz capability.

The 5725A is a companion instrument to the 5700A. It increases the maximum current output of the calibrator to 11A for calibrating the high current ranges of popular handheld DMMs. It also extends the 5700A's alternating Volt-Hertz product to 100V at 30 kHz and 750V at 100 kHz to cover the calibration requirements of high-accuracy bench and system meters.

See page 187 for full description

NEW 742A Resistance Standards



- Small and rugged
- No oil or air baths required
- 18°C to 28°C operating range
- Six month stability to 2.5 ppm

Fluke 742A Standard Resistors are high accuracy working standards for precision, on-site resistance calibration.
They are small, rugged and easy to transport. No cumbersome oil or air baths are required. The 742As are ideal for supporting the Artifact Calibration of the 5700A Calibrator.

See page 228 for full description

NEW 7400 Series Automated Calibrated Systems

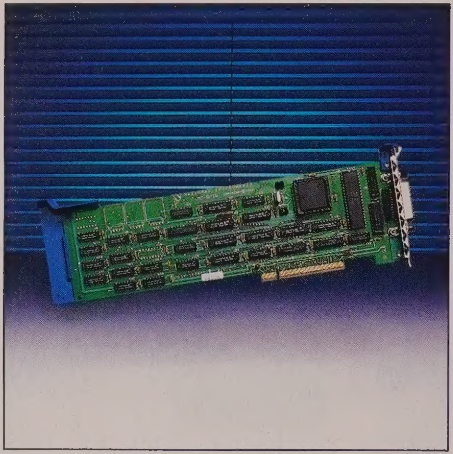
- Choice of PC-compatible or Fluke 1722A instrument controller
- A wide selection of calibrators, packaging, auxiliary instruments and support are available.
- Easy to learn and to use

Fluke 7400 Series Automated Calibration Systems are designed to offer you a complete solution to the complex task of matching the calibrator, host computer and software, packaging and other accessories with your workload requirements and your budget.

See page 220 for full description

New Products

NEW PM 2202 MC-GPIB Interface Board for IBM PS/2



- Turns an IBM PS/2 into a versatile GPIB/IEEE-488 controller
- Hardware configuration completely software programmable
- Easy to use GPIB/IEEE-488 drivers for BASIC, C and Pascal
- Programming of GPIB/IEEE-488 instruments easy with PM 2230 Series, PM 2240 and PM 2260 GPIB software packages

The PM 2202 is an extremely advanced GPIB/IEEE-488 interface for the IBM Personal System/2 (equipped with Micro Channel plug-in-slots). The PM 2202 consists of an interface card plus driver software, and turns the PS/2 into a flexible instrument controller for systems with up to 14 instruments. The interface board allows a maximum transfer rate of 1 MByte/sec, fast enough for the most demanding applications. All board settings are fully programmable and installation is quick and simple. The PM 2202 supports all commonly used GPIB/IEEE-488 functions, with routines that can be included in application programs written in GWBASIC, BASICA Microsoft™ Pascal and Microsoft C. Besides standard GPIB drivers, the PM 2202 is supported by software packages specifically designed to ease programming, debugging and waveform processing. It is software compatible with the PM 2201 GPIB interface for the IBM PC, so application software written for the PC or PS/2 can be exchanged without modification.

See page 379 for full description

NEW PM 2230 Series of GPIB Instrument Drivers

- Automatic configuration utility for fast system configuration
- High level instrument commands ease programming
- Extensive built-in error checking and reporting
- Includes easy to use GPIB/IEEE-488 drivers
- Support for BASICA, Pascal, C & QuickBASIC
- Available for IBM PC's and PS/2's

PM 2230 Series of instrument drivers simplifies programming GPIB/IEEE-488 instrumentation systems and results in self-documenting, error-free application programs. The automatic configuration utility determines the GPIB system configuration, including instrument addresses and type, and assigns a user-defined name to each instrument. Application programming can thus start immediately after running this utility. High level instrument drivers have commands as simple to understand as the instrument front panel, reducing programming time and resulting in easy-to-read application programs. The instrument drivers automatically check program validity; for example, programming an instrument out of range, or programming an incorrect combination of settings, results in clear, readable, error messages. In addition to supporting a large range of Fluke & Philips instruments, the instrument drivers contain a complete set of GPIB procedures for controlling any GPIB instrument, and support BASICA/GWBASIC, QuickBASIC, Microsoft C & Pascal.

See page 376 for full description

NEW PM 2240 TestTeam Software

- Fast, easy program generation for GPIB/IEEE-488 instrumentation set-ups
- Easy to use, menu-oriented operation with pull-down menus and pop-up windows
- Extensive instrument library
- Parameters programmed by on-screen instrument panels
- Built-in graphics and analysis functions for simple on-screen data presentation
- Powerful debugging & error handling tools for error-free programs
- Available for IBM PC's or PS/2's

The PM 2240 TestTeam provides a complete, easy-to-use programming environment for GPIB/IEEE-488 application programs in Microsoft™ QuickBasic or C. Application programs are written using a user-friendly, visual editor and functions are selected via pulldown menus or pop-up windows. A built-in instrument library supports an extensive number of instruments and programming a GPIB instrument is accomplished by simply selecting from an on-screen instrument panel. Standard graphics and analysis libraries greatly simplify presentation of measurement data on screen or in printed form. Extensive debugging and error handling facilities are included.

See page 374 for full description

NEW

PM 2260 Oscilloscope Signal Processing Software

- Extensive waveform analysis and display functions all accessible via menus and function keys
- Menu driven data transfer from Philips Digital Storage Oscilloscopes to PC
- Fast data transfer via GPIB/IEEE-488
- On-line help facility

The PM 2260 Oscilloscope Signal Processing (OSP) software combines the extensive range of waveform analysis functions of the ASYSTANT™-GPIB software package, with the very advanced data acquisition capabilities of Philips Digital Storage Oscilloscopes (DSO). Data captured with a Philips DSO can be easily transferred to the PC via the GPIB/IEEE-488 interface, under control of a menu-oriented driver, with no programming skill or effort required. On the PC, data can then be quickly analyzed, processed and displayed. Processing functions include FFT, power spectrum, inverse FFT, differentiation, integration, Blackman window, curve fitting, cross-correlation and many more. Additional mathematical functions include extensive array operations, statistics and multi-window graphics facilities. Hard copy output to printers and plotters is also supported.

See page 377 for full description

NEW

Touch control screen software development tools

- ScreenBuilder™ for stored screen development
- IconBuilder™ for custom character font development
- TCS Toolbox™ for simplified application program development

ScreenBuilder is a development tool that allows the user to completely develop stored screens for the 1030 or 1050 Series TCS. The user simply "fills in the blanks" on this interactive program that runs on the IBM PC or equivalent.
IconBuilder allows the user to create character fonts and icons for custom displays on the 1030 and 1050. As with ScreenBuilder, IconBuilder is an interactive, "fill in the blanks" program that runs on the PC.
The TCS Toolbox provides a programmer with QuickBASIC functions that greatly simplify the development of a run-time application program. While the TCS Toolbox can be used with any 10XX TCS product, it is best suited for the 1020 Series.

See page 434 for full description

NEW

PM 8238 Multipoint data recorder

- Long term reliability for chart recording
- Maximum 30 input channels, scanned at 10/s
- Graphic or numeric data presentation
- Optional alarm output plug-in cards
- Interpolation between measuring points for continuous line-plots
- Memory modules for user-program storage
- AX + B scaled measurements

The PM 8238 30-channel data recorder is ideal for applications requiring long term stability and reliability, such as extended unattended recording. Chart output is in numeric format (for clear presentation of values), graphic (for spotting trends), or both in combination. Accurate measurement of temperature and voltage covers a span of 1 mV to 30 V and the thermal printing system ensures long term, high quality printing even in dusty environments. All functions or parameters entered for a channel can be quickly selected and verified on the LED display; and a scaling function allows outputs to be displayed in any required units. An internal clock allows time/date labelling. User set-ups and programs can be stored in memory modules, and a choice of IEEE-488 or RS 232C interface options also allows remote control of all data recording activities.

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Alphabetical

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☐ G0 **Bus/Interface Instruments** (System Switches, Controllers, GPIB Interface Cards)
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Oscilloscopes

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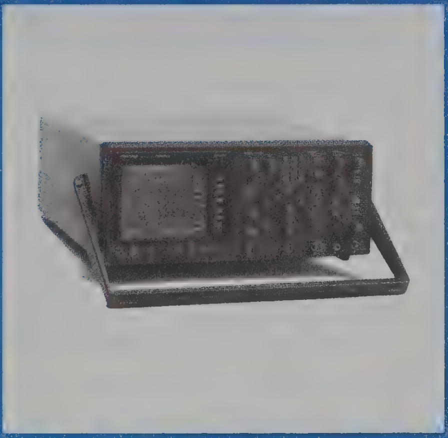
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The range of oscilloscopes detailed in this section covers R&D, production, and service applications.

It includes a complete range of 60, 100, 200 and 400 MHz analog oscilloscopes, most featuring Philips' innovative AUTOSET capabilities. This sets channel amplitude, timebase and triggering to give fast, single button measurements of unknown signals. This range also offers GPIB/IEEE-488 interface capabilites.

Analog storage models offering storage writing speeds up to 1 div/ns are also included.

In addition, digital storage oscilloscopes range up to 2 Ghz response, and feature the fast 250 MS/s, 200MHz PM 3320A, and the new PM 3365. This 100 MS/s, 100 MHz oscilloscope offers a cost effective solution to a great number of applications formerly covered by analog storage techniques, yet with an ease of use comparable to an analog scope.

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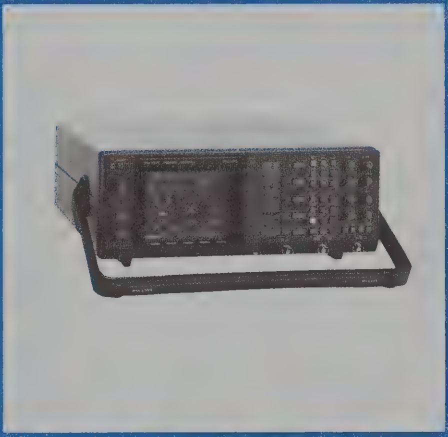
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Selection Guide

Model	Bandwidth (Risetime)	Timebase	Trigger Bandwidth	Acceleration Voltage	Channels	Dual Timebase	Cursors	GPIB	Autoset	Page
Analog Oscilloscopes										
PM 3295A/96A	400 MHz (0.875 ns)	1 ns/div.	400 MHz	24 kV	2 + 1	YES	YES	YES (95A OPT.)	YES	7
PM 3285A/86A	200 MHz (1.75 ns)	2 ns/div.	250 MHz	16 kV	2 + 1	YES	YES	YES (85A OPT.)	YES	7
PM 3070	100 MHz (3.5 ns)	5 ns/div.	150 MHz	16 kV	2 + 1	YES	YES	YES (OPT.)	YES	11
PM 3065	100 MHz (3.5 ns)	5 ns/div.	150 MHz	16 kV	2 + 1	YES	NO	YES (OPT.)	YES	11
PM 3264	100 MHz (3.5 ns)	5 ns/div.	100 MHz	17 kV	4 + 1	YES	NO	NO	NO	16
PM 3055	50 MHz (7 ns)	5 ns/div.	100 MHz	16 kV	2 + 1	YES	NO	YES (OPT.)	YES	11
PM 3050	50 MHz (7 ns)	5 ns/div.	100 MHz	16 kV	2	NO	NO	YES (OPT.)	YES	11
Analog Storage Oscilloscopes										
PM 3266	100 MHz (3.5 ns)	5 ns/div.	100 MHz	10 kV	2 + 1	YES	NO	NO	NO	19
PM 3219	50 MHz (7 ns)	10 ns/div.	50 MHz	8.5 kV	2	YES	NO	NO	NO	21

Digital Storage Oscilloscopes

Models	Bandwidth (Risetime)	Sample Rate	Max. Stored Frequency	Acquisition Memory	Ref. Memory (Waveforms)	Vertical Resolution	Channels	Waveforms On Screen	Cursors	GPIB	RS-232	Page
PM 3340	2 GHz (175 ps)	—	2 GHz	0.5k	1.5 k (6)	10-bit	2	8	YES	STD	STD	26
PM 3320A	200 MHz (1.75 ns)	250 Ms/s	200 MHz	4k	12k (6)	10-bit	2	8	YES	OPT	OPT	31
PM 3308	100 MHz (3.5 ns)	40 Ms/s	100 MHz	8k	180k (99)	8-bit	2	4	YES	STD	STD	37
PM 3365	100 MHz (3.5 ns)	100 Ms/s	100 MHz	4k	4k (2)	8-bit	2	4	YES	OPT	OPT	43
PM 3350	50 MHz (7 ns)	100 Ms/s	10 MHz	4k	4k (2)	8-bit	2	4	YES	OPT	OPT	41
PM 3335	50 MHz (7 ns)	20 Ms/s	2 MHz	8k	8k (2)	8-bit	2	4	YES	OPT	OPT	47
PM 3305	35 MHz (10 ns)	2 Ms/s	35 MHz	2k	2k (2)	8-bit	4	8	NO	OPT	NO	50

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Oscilloscopes Introduction

Oscilloscopes are available from a wide variety of sources and manufacturers. The number of sources available however, becomes limited, when such elements as design innovation, excellence of engineering and worldwide service and parts support are evaluated. Philips oscilloscopes are the products of one of the worlds largest electronics' companies, with annual sales in excess of $ 29 Billion, and yearly budgets of over $ 1 Billion spent on basic research. These total capabilities in analog and digital electronics, manufacturing and fabrication techniques, in addition to worldwide service and support, make the choice of a Philips oscilloscope in many applications a prudent decision.

Selection Criteria

In the following paragraphs, a number of functions for analog oscilloscopes are discussed, along with the selection criteria for each. (For more information on Digital Storage Oscilloscopes, see page 23).

What Are the Functional Blocks of an Oscilloscope?

CRTs

One of the last surviving species of the vacuum tube family, Cathode Ray Tubes (CRTs) are the prominent display devices used in Radar, Computers, Medical equipment and Oscilloscopes. Except for oscilloscopes, most of the CRTs for these applications use some form of electromagnetic deflection.

In an oscilloscope CRT, deflection is electrostatic, allowing a wide range of voltages and frequencies to be displayed with a minimum of distortion.

What CRT criteria are most important to the user?

- Accelerating potential, determining light output and writing rate, important when viewing low repetition rate signals at high sweep speeds. Philips oscilloscopes offer the highest acceleration potentials in each bandwidth/price class, ensuring maximum visibility of the signals under the most demanding measurement circumstances.
- Screen size, usually measured in centimeters.
- Graticule, external or (mostly) internal, to avoid parallax.
- Graticule illumination for photographic recording.

Multiple Channels

Many oscilloscope applications require the ability to compare two or more waveforms to show amplitude differences, distortion, or time differences.

Dual Beam oscilloscopes allow the comparison of waveforms by using a CRT with two electron guns and two deflection systems, to display two completely independent oscillograms on the same screen.

In such an arrangement, two completely independent amplifier systems are required and they must be matched properly so as to not introduce distortion or time differences of their own. At higher frequencies this becomes a more difficult requirement to meet, and prohibitively expensive for most applications. Most analog oscilloscopes therefore operate on the Dual Trace principle described below.

Digital storage oscilloscopes with synchronous Analog to Digital conversion on each channel prove to be excellent replacements for the Dual Beam oscilloscope.

Dual Trace

The most common way to display two (or more) signals on the screen of an analog oscilloscope uses the dual trace principle.

Input signals are connected to the output amplifier and CRT deflection system in turn, in a time-shared manner, using an electronic switching arrangement between channels which is either free-running at a high frequency (CHOP) or changes channels at the end of every sweep (ALTERNATE). Philips oscilloscopes feature the highest CHOP frequencies in their respective bandwidth class, so as to ensure proper displays at the highest possible sweep rates, without visible interference of channel switching.

Some oscilloscopes are designed to display more than two channels in this fashion, either by having more than two full vertical input channels, or by allowing a trigger signal to be displayed. The Philips PM 3264 l00 MHz four channel oscilloscope offers the convenience of four complete vertical channels, each with its own full-range sensitivity setting, plus a fifth channel trigger view.

Vertical Channels

A vertical channel is comprised of: An input connector, Coupling selector for AC or DC coupling, Selection of input impedance (only in VHF scopes), Attenuator or sensitivity adjustment, Position control, (Display invert switch), (DC-offset).

What Amplifier criteria are most important to the user?

- Bandwidth, specified as the frequency range between DC and the point where the frequency characteristic has fallen to its -3 dB point. Philips analog oscilloscopes are available with bandwidths beginning at 15* MHz, up to 400 MHz.
- Risetime. The risetime and bandwidth of an oscilloscope have a known relationship to each other: Risetime (in ns) x Bandwidth (in MHz) = 350.
- The risetime of an oscilloscope determines the ability of the instrument to deal with short events, such as rise times of components used, glitches etc.

**20 MHz in U.S.*

- To determine the required risetime (or Bandwidth) of an oscilloscope to perform a particular measuring task, the following may be helpful:
  $T(\text{observed}) = \sqrt{T(\text{signal})^2 + T(\text{oscilloscope})^2}$
  Philips oscilloscope rise times are always specified at the tip of the probe delivered with the instrument.
- Maximum sensitivity, expressed in mV/div to be able to cope with spurious signals: crosstalk, power supply ripples, faulty components.
- Minimum sensitivity, expressed in V/div, to include direct measurements of high amplitudes, such as line, HV power, etc.
- Accuracy, in %.
- Maximum input (overload) voltage permissible at the input without causing damage, to reduce cost of ownership.
- Choice of input impedance. Most oscilloscopes are equipped with inputs of 1 Mohm, in parallel with their input capacitance. Philips oscilloscopes have unusually low input capacitances (only 9 pF in the 200 MHz and 400 MHz models).

  All Philips oscilloscopes with bandwidths of 200 MHz and higher offer a choice of 50 ohm inputs. This serves two purposes :

  1. To provide a convenient and proper termination to coaxial cables when working in a 50 ohm environment.
  2. To allow the use of low impedance passive 10x and 100x probes with extremely low input capacitances of 1 pF.
     (See PM 8911/09 and PM 8912/09).

Timebases

Sweep generators generate a voltage, the value of which increases linearly with time. This linear ramp voltage is fed into the horizontal amplifier of the instrument and calibrated in time. The timebase generator does not start its sweep until triggered by a trigger signal.

When each successive sweep is triggered at the same level and slope of an incoming repetitive signal, sweeps will always start at the same point of the signal, and a stable, jitter-free display is obtained.

What Timebase criteria are most important to the user?:

- Minimum sweep speed, expressed in sec/div.
- Maximum sweep speed, expressed in microsec/div or nanosec/div
- Accuracy
- Linearity

Triggering

Triggering is the mechanism which defines the starting point of every successive sweep. It defines the stability of the display and is usually the most prominent characteristic of the user-friendliness of the entire instrument. Trigger signals are obtained from either a vertical channel (Internal triggering), or an external source.

Introduction

What Triggering characteristics are most important to users?

- Choice of trigger sources, to help find and set up the most stable trigger and display condition for each application. Philips oscilloscopes invariably offer a full complement of trigger source selection to tackle the most demanding and complex waveforms.
- Maximum triggerable frequencies, also defining the ability to trigger on small signal details and glitches. Philips oscilloscopes trigger well beyond their rated bandwidth.
- Trigger jitter, or rather the lack thereof, to assure stability of display.
- Automatic trigger level adjustment or manual adjustment between automatically detected signal limits. This translates to ease of operation. Thanks to AUTOSET on Philips oscilloscopes, trigger source, trigger level, timebase speed and vertical sensitivity are all automatically set for instant signal viewing.
- Features such as High or Low pass filters, Trigger view.
- TV triggering capabilities to deal with Video signals as are found in TV sets, cameras, VCR's, but also Radar, Medical and Computing equipment. In such applications, Philips video triggering capabilities are exceptional.
- In order to permit viewing the triggering edge of a waveform, all Philips oscilloscopes are equipped with a delay line in the vertical amplifier chain.

Dual Timebase/Delayed Sweep

To resolve signal details in time and to allow for more accurate timing measurements, many oscilloscopes with bandwidths of 50 MHz or more are available with two timebases, so that one serves as a delay generator for the other.

Signal details are identified with an intensified portion of the display of the main timebase (MTB), which can then be selected to be displayed across the entire screen width, using the delayed timebase (DTB).

Delay is calibrated in divisions, which can be calculated into time, taking the timebase speed of the main timebase (MTB) into account. Modern Philips microprocessor-operated scopes perform this calculation automatically and present calibrated delay values in time.

What Delayed Sweep criteria are most important to the user?:

- Choice of models with, or without delayed sweep. Sometimes, single timebase models are preferred to save (some) money in the purchase price, but especially in training requirements of personnel.
- User friendliness. Philips delayed sweep oscilloscopes are always easy to use with their clear, and uncluttered layout and separate control areas for main and delayed timebases.
- Direct readability of delay in time. All Philips microprocessor operated oscilloscopes offer this convenience.
- Triggering capabilities of the delayed timebase. All Philips delayed sweep oscilloscopes offer a full, and independent choice of trigger settings for their main- and delayed timebases: A MUST for every type of measurement in the digital field.

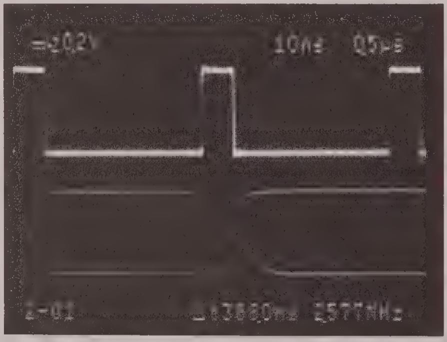
Dual Delayed Sweep

By alternating delay times between successive sweeps of the main timebase generator, TWO signal details can be identified along the sweep of the main timebase, and the difference in time is measured.

This capability is referred to as dual delayed sweep or delta-time capability. Some Philips oscilloscopes permit the measurement of time delays between one detail in one channel, and another detail in another channel.

What Dual Delayed Sweep criteria are most important to the user?:

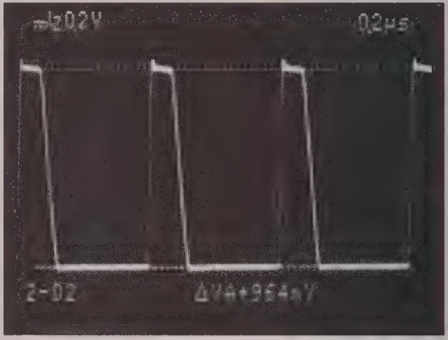
- User friendliness
- Readability of delta time
- Capability to read the inverse of time, expressed as frequency.
- Ability to measure between channels.



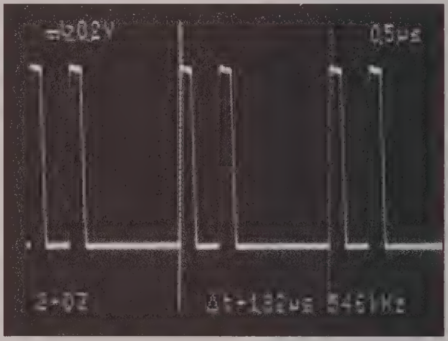
Accurate time readouts are easily obtained with the PM 3296A's delta time dual delayed sweep arrangement.

Cursors Measurements on Analog Scopes

Cursors on analog scopes are movable lines, replacing the role of the graticule lines. Adjustments are always made by the operator. Distances between the cursors are displayed alphanumerically and represent amplitude or time. Cursors add convenience to oscilloscope measurements. Voltage accuracy is determined by the accuracy of the overall attenuator and amplifier chain. Timing accuracy is determined by the accuracy of the Main timebase. When small timing increments are to be measured, measurements using delta-time facilities as described above offer better accuracy.



The PM 3296A's cursors allow easy readouts of absolute and relative amplitudes.

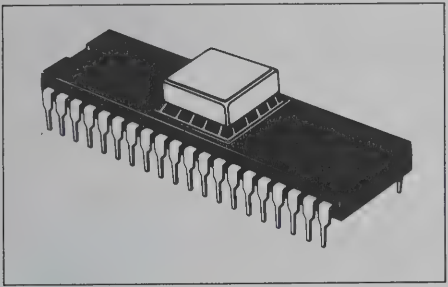


Cursors can be used for time readouts as well. Time intervals are presented in (fractions of) seconds. 1/T readouts are presented in Hz.

Operation

Autoset

Most Philips oscilloscopes are microprocessor operated. The intelligence of the microprocessor, along with the cold switching technology employed in many Philips instruments, combine to offer the industry's first, and most complete AUTOSET feature. AUTOSET is a one-button feature, which automatically selects the proper channel(s), selects the proper trigger source and other trigger conditions, and sets attenuator and timebase ranges. AUTOSET not only speeds up operation with known signals, it helps find unknown signals during trouble shooting, with great ease. AUTOSET is available on Philips 60, 100, 200, 400 MHz analog scopes as well as on the Digital Storage models PM 3308, PM 3320A, PM 3335, PM 3340, PM 3350 and PM 3365.



Ease of Use

The AUTOSET feature on many Philips models, as well as the clear and logical front panel layouts ensure ease of use throughout the product line. For many routine tasks in production and service, a number of Philips oscilloscopes are available with extensive menu operation, in which complete front panel setups can be stored in non-volatile memories, and recalled at random, or in sequences.

Engineering Excellence and Durability

Philips is a recognized leader in CRT technology and electron-optics. CRT's used in Philips oscilloscopes are glass-envelope, high lead content, low radiation types. Philips oscilloscopes meet or exceed even the tough West-German requirements on X-ray radiation. Excellent display sharpness and intensity are obtained by such elements as high acceleration potentials, dynamic focusing, TDR adjusted helix deflection systems and magnetic error correction.

Controls on many Philips oscilloscopes are not what they used to be:

Complex, failure prone electro-mechanical devices such as attenuator and timebase switches have been replaced by microprocessor controlled, sealed switching arrangements in reed-relays and solid state, so that switch failures and worn or dirty contacts are a thing of the past. Reliable and stable operation is assured over long lifetimes.

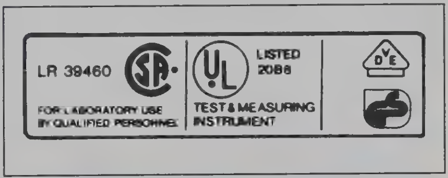
Power supplies in many Philips oscilloscopes are high-efficiency, direct-conversion types that operate over wide ranges of supply voltages and frequencies. Their high efficiency ensures cool operation of the instrument, adding to the overall reliability. Philips oscilloscopes are available for world wide use, many without the need of range-switching or fuse changes. See product descriptions for details.

Quality Assurance and Reliability

All Philips oscilloscopes meet stringent published requirements regarding environmental characteristics. Many of these requirements are referenced to MIL 28800 D. See product description for details.

Safety

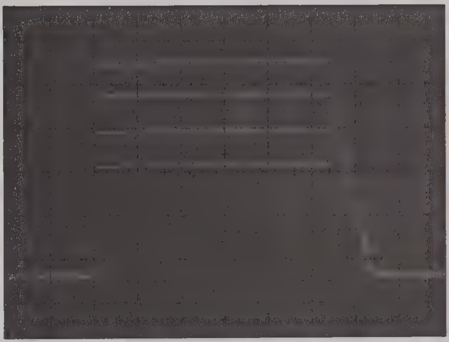
All Philips oscilloscopes meet the requirements on instrument safety per IEC 348. Most Philips oscilloscopes are UL listed (UL 1244) and CSA approved (CSA 556 B), and meet VDE D411. See product descriptions for details.


LR 39460
SP
FOR LABORATORY USE BY QUALIFIED PERSONNEL
UL
LISTED 2088
TEST & MEASURING INSTRUMENT
DVE

Analog Storage Oscilloscopes

(For more information on Philips Digital Storage Oscilloscopes, see page 23)

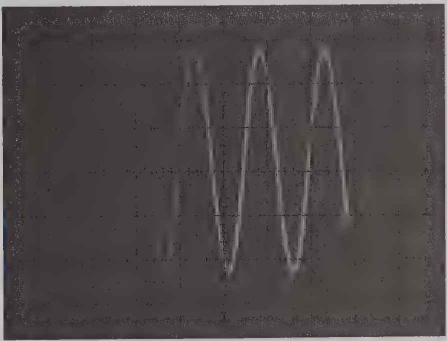
Most oscilloscopes are supplied with CRTs having a P 31 phosphor. This phosphor type has a short persistence, and is adequate for all applications in which signals have repetition rates of 40 Hz or more. Below such rates, image flicker becomes annoying and single events can not be observed or measured. For these situations, Storage Scopes offer a solution by storing signals with low frequencies down to single shots and displaying them during a longer time period.



An analog storage oscilloscope's ability to store multiple traces, as shown here taken from a PM 3219. Example: Multiple trace images like these are used in medical electronics and industrial electronics to verify X-Ray equipment performance at various acceleration potentials.

Analog Storage oscilloscopes store images inside their CRT. To this day, these instruments are capable of storing the shortest events by offering the highest writing speeds; the ability of the instrument to capture and display fast single events at high timebase speeds. (See PM 3266)

Analog Storage scopes also offer Variable Persistence, to allow the user to observe slow trend changes in repetitive signals, or to permit low frequency signals to be displayed without flicker.



Variable persistence is a convenience feature when observing low frequency signals or signals with slow variations in amplitude or time.

Storage Scopes can not only store and display single events: they can also enhance displays of signals that may otherwise be (almost) invisible: fast glitches or short rise times that occur at low repetition rates.

What Analog Storage Scope characteristics are most important to the user?:

- Writing speed, expressed in cm/microsec, or cm/nanosec. The Philips PM 3266 offers 1 cm/ns across the entire screen area!
- Halftone storage, offering variable persistence and (often overlooked), the ability to enhance image brightness for low repetition rate signals that might be impossible to see with a non-storage scope. Both the PM 3219 and PM 3266 offer variable persistence.

Introduction

Storage Oscilloscope Selection Criteria

Listed below is a comparison between the typical characteristics of Analog, or CRT storage, and Digital Storage oscilloscopes.

	CRT Storage	**Digital Storage***
Available Models	PM 3219 PM 3266	PM 3305 PM 3308 PM 3320A PM 3335 PM 3350 PM 3365 PM 3340
Speed	Highest writing speed available : 1 div/ns (PM 3266)	Highest single event sampling speed of 250 Ms/s (PM 3320A)
Memories	One : the screen	Up to four memories built in.
Memory Size	8x10 cm	Up to 10 bits x 4k (PM 3320A, PM 3340)
Multichannel Recording	Limited by CHOP frequency	Up to 250 Ms/s for each channel (PM 3320A)
Storage Time	Limited by CRT	Unlimited with power on Memory backed up in most Philips DSO's.
"Baby Sit Mode"	Limited by CRT Max. of 24 hrs in PM 3219.	Unlimited storage time.
Outputs	The screen	1. The screen 2. Analog out for X-Y recorders 3. IEEE 488 4. RS 232
Hard Copy	Screen photos	1. Screen photos 2. X-Y recorder 3. Plotter
"Soft Copy"	None	Mass storage in instrument controller, or RAM (PM 3308)
Automation	None	1. Built-in menus (PM 3320A, PM 3340) 2. Thru IEEE 488 or RS 232
Display	1. Normal, no memory 2. Variable persistence 3. Integration of intensity for enhanced visibility 4. Stored, variable brightness	Always at a uniform brightness, regardless of signal frequency and timebase speed
Cost of Ownership	Every storage CRT is expensive and represents a major expense when damaged.	CRT can not be damaged by operator error.

**For more information on Digital Storage Oscilloscopes, see page 23.*

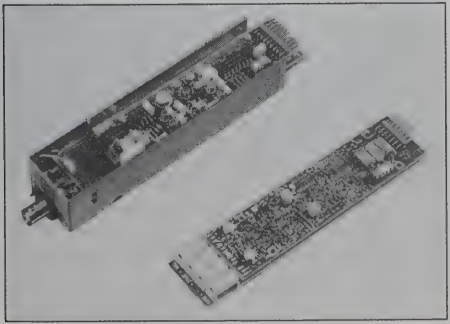
PM 3285A, PM 3286A, PM3295A & PM 3296A

GPIB
IEEE-488

PM 3285A/86A 200 MHz & PM 3295A/96A 400 MHz Oscilloscopes
Bandwidths of 400 MHz and 200 MHz
Risetimes of 0.9 ns at the probe tip (1.75 ns for PM 3285A/86A)
High visual writing speed CRT's
AUTOSET
Menu operation from 75 non-volatile memories
Cursor measurements for volt, time and frequency
Dual delayed sweep
LCD and LED status information for positive feedback

Performance

The PM 3285A/86A and PM 3295A/96A VHF oscilloscopes redefine portable, monolithic oscilloscope capabilities. With more capabilities and more straight foward operation than you will find in other portables.



The PM 3295A/96A split-band, drift corrected pre-amplifier, using state-of-the-art SMD technology.

Up to 400 MHz bandwidth offers portable sub-nanosecond performance all the way to the probe tip. Excellent for a wide array of applications including communications, avionics, radar, data processing and video processing.

CRT's with 24 kV acceleration potentials for optimum viewing. Ultra-fast writing speeds of up to 4 div/ns reveal the most elusive details and the narrowest glitches — even at high sweep speeds and low signal repetition rates. Triggering performance is in excess of 400 MHz, stable, and easy to use.

Probe factors are read out automatically. Philips probes automatically adjust the input for proper impedance setting and, where appropriate, sensitivity ranges. 50 Ohm input impedance can be selected. The 50 Ohm termination is protected by software, as well as a thermal sensor on the thin film circuit, causing the microprocessor to disconnect the 50 Ohm load, when overload conditions lead to overheating.

Autoset

Philips' AUTOSET is the first and the most comprehensive intelligent beamfinder available. It automatically selects the proper channel and trigger source for a properly triggered display, and sets amplitude and timebase speed to obtain optimum viewing of almost any input signal, even unknown, at the touch of just one button.

Built-in Programmability

For quick, correct measurements in routine tasks time after time, the PM 3286A and PM 3296A models offer programmability without a computer, by offering up to 75 front panel setups to be stored in non-volatile memory. These menus can be stored, modified and recalled at random or in sequences by using Philips IR remote control.

Cursor Measurements

On-screen cursors let you measure waveform parameters exactly as you see them, easily, with the screen providing numeric readouts of voltage, time and frequency. Absolute and relative measurements (referred to any reference as 100%) can be easily obtained.

Delayed Sweep and Delta-Time

Both timebases can be set to up to 1 ns/div, to match the risetime performance of the vertical channels (2ns/div for PM 3285A series). Delay values are visible in the screen and on the backlit LCD. The dual delayed delta time feature permits accurate differential time and frequency measurements.

Trigger Level Readout

Trigger levels can be set and adjusted using the level readout on the screen. Levels are displayed in divisions, or volts, for internal and external triggering respectively.

PM 3285A, PM 3286A, PM3295A & PM 3296A

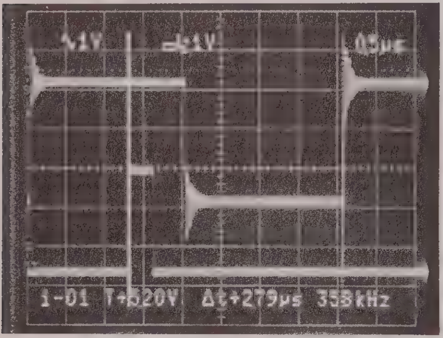
High Performance Engineering

Operation is based on microprocessor controlled cold-switching, in which all signal paths are switched in sealed environments, with no switches to wear out, or get dirty, ever. Not only does this arrangement enhance reliablity, it also permits the full implementation of before-mentioned AUTOSET, and programmability. Opto-encoders replace the front panel switches and provide control over the internal bus.

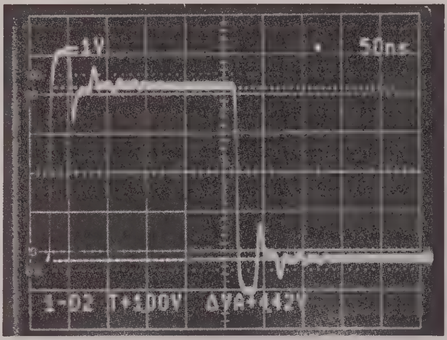
Programmability

GPIB/IEEE-488* is fully implemented in the PM 3286A and PM 3296A, at no extra charge. All front panel settings except intensity and focus are programmable. The controller can always interrogate the units' settings via the IEEE-488 bus. Programmability is further enhanced by the instrument's menu storage, allowing the scope to be controlled by simple, single commands via the bus.

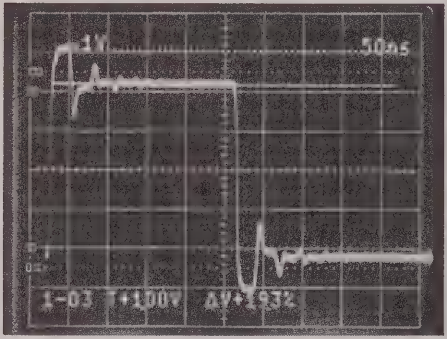
Versatility



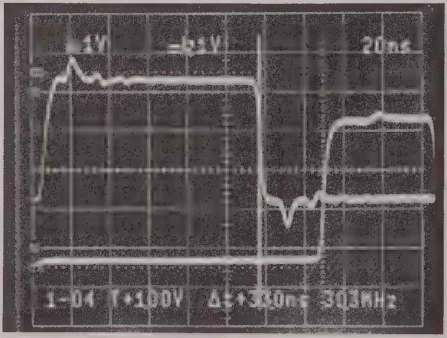
1. At the heart of these portables is Philips' proprietary 8 x 10 cm, 24 kV CRT, assuring bright, clear display of even the fastest signals. Graticule illumination is continuously variable. Intensity controls for traces and text are separate.
A complete information center, the screen exhibits input impedance, input coupling and scalefactor for each channel. Probefactors are automatically recalculated.
Timebase speeds are displayed and corrected for magnifier use.
Delta time or cursor readouts appear in the lower righthand corner.
Trigger level is displayed in Volts (for Ext trigger) or Div (for Int trigger). Cursor time readouts are displayed in delta time and Hz.
Setting readouts are duplicated in LEDs and backlit LCDs on the front panel.
Input impedance is automatically set by the probe, so no mismatch can occur. Note the test sequence number in the lower left corner of this PM 3296A display.



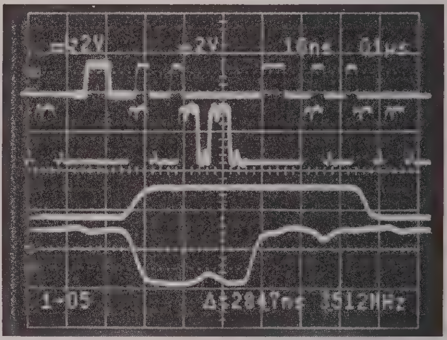
2. Channel is DC coupled at 1 V/div. Timebase is set at 50 ns/div. Cursor readout of pp amplitude is 4.42 Volts, and is referred to as 100% for the overshoot measurement in picture 3.



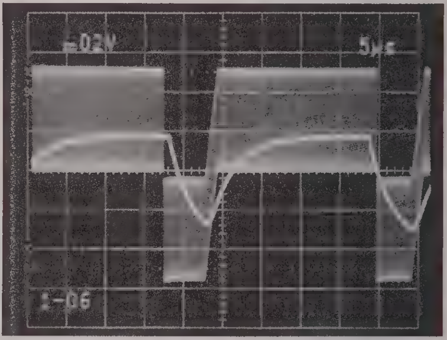
3. The PM 3296A's ability to set any amplitude as a reference lets you take quick readings of overshoot percentages — as in this picture — or measure modulation depth of an AM signal.
Note that the scope can perform relative measurements while channels remain calibrated.



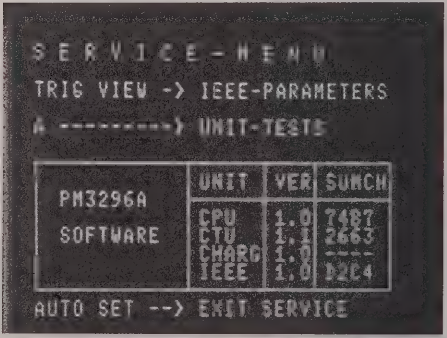
4. Cursors can be used to measure time between two events in the same signal, or between signals. Readout is in (fractions of) seconds, or in Hz.
Time measurements using cursors are simple to make and permit relative time readings on any time section using calibrated timebase settings.



5. When the waveform is too complex to properly set the cursors, better accuracy can be obtained by using delta-time delayed sweep.
Alternative timebase display mode allows you to view the total time-window and, at the same time, magnify signal detail for proper identification.



6. Triggerview can be used as an extra input channel, and also to verify proper trigger conditions.
Here, the trigger signal is obtained from channelA, and contains enough noise that it would make the display unstable and fuzzy.
Trigger selection is from channel A through HF reject. Lower trace shows signal after filtering through HF reject.
Note that the trigger level is midscreen for easy reference and setup.



```
SERVICE-MENU
TRIG VIEW -> IEEE-PARAMETERS
A ---------> UNIT-TESTS

 PM3296A        UNIT  VER  SUMCH
                CPU   1.0  7487
 SOFTWARE       CTU   1.1  2663
                CHARG 1.0  ----
                IEEE  1.0  B2C4

AUTO SET --> EXIT SERVICE
```

7. The PM 3296A's extensive service menu facilitates performance check and calibration. Many adjustments can be performed by using internally generated signals to save calibration time.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 3285A, PM 3286A, PM3295A & PM 3296A

Specifications

Technical Specifications

Autoset

Selects channel, amplitude, vertical position, timebase speed and triggering for surveyable display of input signal.

Display

CRT: Philips rectangular pda tube
Viewing Area: 8 x 10 cm
Acceleration Voltage: 24 kV (PM 3295/96A); 16.5 kV (PM 3285/86A)
Phosphor: Type GH (P31)

Readout: Alphanumerical display of relevant vertical and horizontal function selections, deflection coefficients and cursors.
Graticule: Internal with % indications for rise-time measurements. Illumination continuously variable.
Photographic Writing Speed:
4 cm/ns (PM 3295/96A);
2 cm/ns (PM 3285/86A),
with lens aperture F:1.2, object to image ratio: 1:0.5 and filmspeed 20,000 ASA.
External Z-Modulation: Positive voltage decreases intensity

Vertical Deflection

Sources: Y_A, Y_B, Trig view, Y_A and Y_B added. Y_A and Y_B can be inverted
Modes: Single channel or any combination of sources. Alternate or chopped. Display time in chopped mode 350 ns/channel.

Y_A and Y_B

Input Impedance (High Z): 1 MΩ in parallel with 9 pF
Input Impedance (50Ω): V.S.W.R.
1.3:1 at 400 MHz (PM 3295/96A);
1.2:1 at 200 MHz (PM 3285/86A)
Max. Input Voltage (High Z): 300V (DC + AC peak)
Max. Input Voltage (50Ω): 5 Vrms overload protected
Deflection Coefficient: 1 mV/div...5V/div (continuous control between steps)
Error Limit: 2%
Cursor Δt Error Limit: 2% overall

Frequency Response (pm 3295/96A):
DC...400 MHz (-3 dB) (15°C...35°C)
DC...350 MHz (-3 dB) (5°C...40°C)
In 1 mV/div and 2 mV/div settings: DC...70 MHz

Frequency Response (PM 3285/86A):
DC...200 MHz (-3 dB) (15°C...35°C)
DC...175 MHz (-3 dB) (5°C...40°C)
In 1 mV/div and 2 mV/div settings: DC...70 MHz

AC Coupled Lower -3 dB Point: 10 Hz

Rise Time*: .9 ns (PM 3295/96A);
1.75 ns (PM 3285/86A);
In 1 mV/div and 2 mV/div settings:
5 ns (PM 3295/96A);
5.4 ns (PM 3285/86A)
*Rise time calculated using $t_r = \frac{0.35}{\text{bandwidth}}$

Dynamic Range: 24 div up to 100 MHz
CMRR: 100:1 up to 1 MHz; 20:1 up to 50 MHz
Visual Signal Delay: 20 ns
Bandwidth Limiter: Reduces bandwidth to 20 MHz (-3 dB)

Trigger View
Deflection Coefficient: Via EXT. input 100 mV/div or 1V/div; Via Y_A or Y_B 1 mV/div...5V/div
Frequency Response (PM 3295/96A):
Via EXT input: DC...370 MHz (-3 dB);
Via Y_A or Y_B: DC...350 MHz (-3 dB)
Frequency Response (PM 3285/86A):
Via EXT input: DC...200 MHz (-3 dB);
Via Y_A or Y_B: DC...150 MHz (-3 dB)
Delay Between EXT. Input and Y_A or Y_B: 2 ns

Horizontal Deflection

Display Sources: MTB, MTB intensified by single or dual DTB, DTB, MTB and DTB Alternate, EXT., Line. Trace separation between MTB and DTB in ALT mode continuously controllable over at least 4 divisions

Main Time Base
Modes: AUTO, Trig., Single
Deflection Coefficient: 1s/div...10 ns/div (PM 3295/96A);
1s/div...20 ns/div (PM 3285/86A)
(continuous control between steps)
Error Limit: 0.5% of full scale + 1% of reading
Cursor Δt: Error limit 0.5% of full scale + 1% of reading
Frequency Readout: 1/Δt
Time Base Magnifier: x 10 fastest sweep...
...1 ns/div (PM 3295/96A)
...2 ns/div (PM 3285/86A)
Error Limit: 1% of full scale + 1.5% of reading
Variable Hold Off: Up to 10 x min. value

Delayed Time Base
Modes: Starts immediately after delay time or upon first trigger after delay time
Deflection Coefficient:
0.5s/div...10 ns/div (PM 3295/96A);
0.5s/div...20 ns/div (PM 3285/86A)
(continuous control between steps)
Error Limit: 0.5% of full scale + 1% of reading
Time Base Magnifier: x 10 fastest sweep...
...1 ns/div (PM 3295/96A)
...2 ns/div (PM 3285/86A)
Error Limit: 1% of full scale + 1.5% of reading
Delay Time: 20 ns...10s
Error Limit: 1.2% of full scale + 1% of reading + 12 ns
Time Interval (Δt):
10 ns...10s (PM 3295/96A)
20 ns...10s (PM 3285/86A)
Error Limit: 0.1% of full scale + 0.5% of reading + 2 ns
Frequency Readout: $^{1}/t$
Resolution of Delay Time or Δt Control: 1:65,000
Jitter: 1:20,000

Triggering MTB Sources: YA, YB, Composite, EXT, EXT ÷ 10, Line
Coupling: DC, AC, LF REJ, HF REJ
Slope: + or -

Level Range:
Internal: +8...-8 div.
EXT: +0.8...-0.8V
EXT ÷ 10: +8V...-8V
Trigger level is read out on screen if instrument is equipped with GPIB IEEE interface. Standard on PM 3286A/PM 3296A

Triggering Sensitivity

	PM 3295/96A	
	up to 100 MHz	up to 400 MHz
INT	0.5 div.	2 div.
EXT	50 mV	300 mV
EXT ÷ 10	500 mV	3V

	PM 3285/86A		
	up to 100 MHz	up to 200 MHz	up to 250 MHz
INT	0.5 div.	1 div.	—
EXT	50 mV	—	300 mV
EXT ÷ 10	500 mV	—	3V

Triggering DTB: See MTB triggering except for Line triggering

External

Sources: Y_A, Y_B, EXT
Input Impedance Via EXT: 1 MΩ in parallel with 9 pF
Deflection Coefficient Via EXT: 100 mV/div or 1V/div
Frequency Response: DC...2 MHz (3 dB)
Phase Difference Between Y and EXT: 3° up to 100 kHz
Line: 7 div for frequencies of 50 Hz...60 Hz

Signal Outputs

Calibration Voltage: Square wave, positive going
Amplitude: 0.8V ±1%
Frequency: 5 kHz ±0.1%
Impedance: 50Ω ±1%
Y Signal: Selectable via DTB trigger source
Amplitude: 20 mV/div into 1 MΩ; 10 mV/div into 50Ω
Range: 160 MV$_{p-p}$ into 1 MΩ; 80 mV$_{p-p}$ into 50Ω
Frequency: DC...300 MHz (-3 dB) (PM 3295/96A);
DC...200 MHz (-3 dB) (PM 3285/86A)
MTB Gate: TTL compatible
DTB Gate: TTL compatible

Cursors

Voltage Cursors
Cursor Range: Center 7 divisions
Ratio Range: 0.1%...999%; 100% reference at any amplitude

Timer Cursors
Cursor Range: Center 9 divisions
Ratio Range: 0.1%...999%; 100% reference at any time difference

PM 3285A, PM 3286A, PM3295A & PM 3296A

GPIB/IEEE-488 Interface

All functions (except CRT controls) can be controlled or read by a controller via GPIB/IEEE-488 interface bus. GPIB/IEEE address and talker/listener functions can be set by front panel switches in service menu mode. In remote mode front panel is locked (remote LED on) or unlocked (remote LED blinking) by program. In unlocked mode SRQ function is available via AUTOSET.

Power

Voltage Range: 90...264 VAC, one range
Frequency Range: 45...440 Hz
Consumption: 136W
Battery Back-Up: Holds front panel setting when instrument is switched off
Retention Time: 2 years

Environmental Capabilities

The instrument meets the requirements of MIL-T-28800C, type III, class 5, style D.

Temperature
Operating: 0...50°C
Storage: -40...+75°C
Humidity: 95% R.H.

Altitude
Operating: 4.5 km (15,000 ft)
Storage: 12 km (50,000 ft)

Vibration
Frequency Range: 5 Hz...55 Hz
Max. Acceleration: 3g at 55 Hz held 10 min. at each resonance frequency
Shock: 6 shocks each axis, half sine wave pulse, 11 ms duration, peak acceleration 30g
Bench Handling: MIL-STD 810, method 516, procedure V
EMI: MIL-STD 461 class B, VDE 0871, VDE 875 Grenzwert Klasse B
Safety: The instrument meets the requirements of IEC 348 class I, VDE 411, UL 1244, CSA 556B

Mechanical

Height: Without feet and accessory pouch; 170 mm H (6.7 in)
Incl. feet and accessory pouch: 240 mm (9.4 in)
Width: Incl. feet and accessory pouch: 340 mm (13.4 in)
Depth (excl. handle):
PM 3295/96A: 523 mm (20.6 in)
PM 3285/86A: 473 mm (18.6 in)
Depth (incl. handle);
PM 3295/96A: 625 mm (24.6 in)
PM 3285/86A: 575 mm (22.6 in)
Weight:
PM 3295/96A: 13.9 kg (30.7 lbs)
PM 3285/86A: 13.6 kg (30 lb)

Setting Memory (PM 3296A and PM 3286A)
Memory Capacity: up to 75 front panel settings

Infrared Remote Control
Functions: RECALL, NEXT, PREVIOUS...for recall of programmed settings.
Special functions for protection of programmed settings and identification of instruments.
AUTO...for automatic setting-up of front panel for surveyable display of any input signal.
Transmission Type: Infrared
Batteries: 4 x AAA lifetime typically 2 years
Transmission Distance: Typically 10 ft. (3.5m)
Dimensions: 71 mm W x 16 mm H x 173 mm L (2.6 in W x 0.6 in H x 6.8 in L)
Weight: 135g (0.3 lbs)

Environmental Characteristics
Operating Temp. Range: +5...45°C
Storage Temp. Range: -25...+70°C (without batteries)
Unit is splash-proof; no functional failure after drying period of 24 hrs.

Included with the Instrument:
2 x 10:1 passive probes 1m (3 ft) (PM 3295/96A), 2 x 10:1 passive probes 1.5m (5 ft) (PM 3285/86A), Collapsible viewing hood, Blue contrast filter, Front cover, Operating Manual

Ordering Information

Models

January 1989 prices

PM 3285A 200 MHz Oscilloscope	$4400
PM 3286A as above, with 75 menu memory and IR remote control	4950
PM 3295A 400 MHz Oscilloscope	5350
PM 3296A as above, with 75 menu memory and IR remote control	5900

Optional Configurations

When ordering, select the basic "PM" model from above, and add the configuration option number listed below as a suffix.

/003 Basic model, bench/portable configuration (PM 3285A, PM 3295A)	N/C
/303 19" Rackmount version (PM 3285A, PM 3295A)	add 275
/403 Basic model, bench/portable configuration (PM 3285A, PM 3295A), with GPIB IEEE-488	add 400
(PM 3286A, PM 3296A), with GPIB IEEE-488	N/C
/803 19" Rackmount version (PM 3285A, PM 3295A), with GPIB IEEE-488	add 675
(PM 3286A, PM 3296A), with GPIB IEEE-488	add 275

Example, Ordering Information
To order a 400 MHz oscilloscope in bench top/portable configuration, with GPIB/IEEE-488, select:

	Model	Price
Basic Oscilloscope	PM 3295A	$5350
Configuration Option Suffix	/403	400
Complete model number	PM 3295A/403	5750

Accessories (Also see page 53)

Passive Probes

PM 8911/09 500Ω, 10:1 Passive Probe with readout, cable length 3 ft (1m)	$125
PM 8912/09 5 kΩ, 100:1 Passive Probe with readout, cable length 3 ft (1m)	125
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8929/09 10:1 Passive Probe with readout, cable length 5 ft (1.5m)	90
PM 8929/19 10:1 Passive Probe with readout, cable length 3 ft (1m)	90
PM 8929/29 10:1 Passive Probe with readout, cable length 8 ft (2.5m)	90
PM 8931/09 20 MΩ, 100:1 Passive Probe with readout	135
PM 9599/09 Set of VHF Attenuators	200

Active Probes

PM 8940/09Q High Voltage Isolation Amplifier with readout	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe with readout	1000

Other Accessories

PM 9051 BNC to 4 mm Banana Adapter	9
PM 9310/00 Collapsible Viewing Hood	12
PM 9311/00 Long Viewing Hood	85
PM 9381 Oscilloscope Camera	650
PM 9877/00 Camera Adapter for stationary use	150
PM 8991/04 Oscilloscope Cart	450
PM 8992/80 Accessory Pouch	45
PM 8950/951 Service installable Retrofit Kit for GPIB IEEE-488	750
PM 8917/003 Video Sync Separator and Line Selector	550
PM 2195/09 GPIB controlled Probe Switch 400 MHz	650
PM 2240/001 TestTeam Software	925

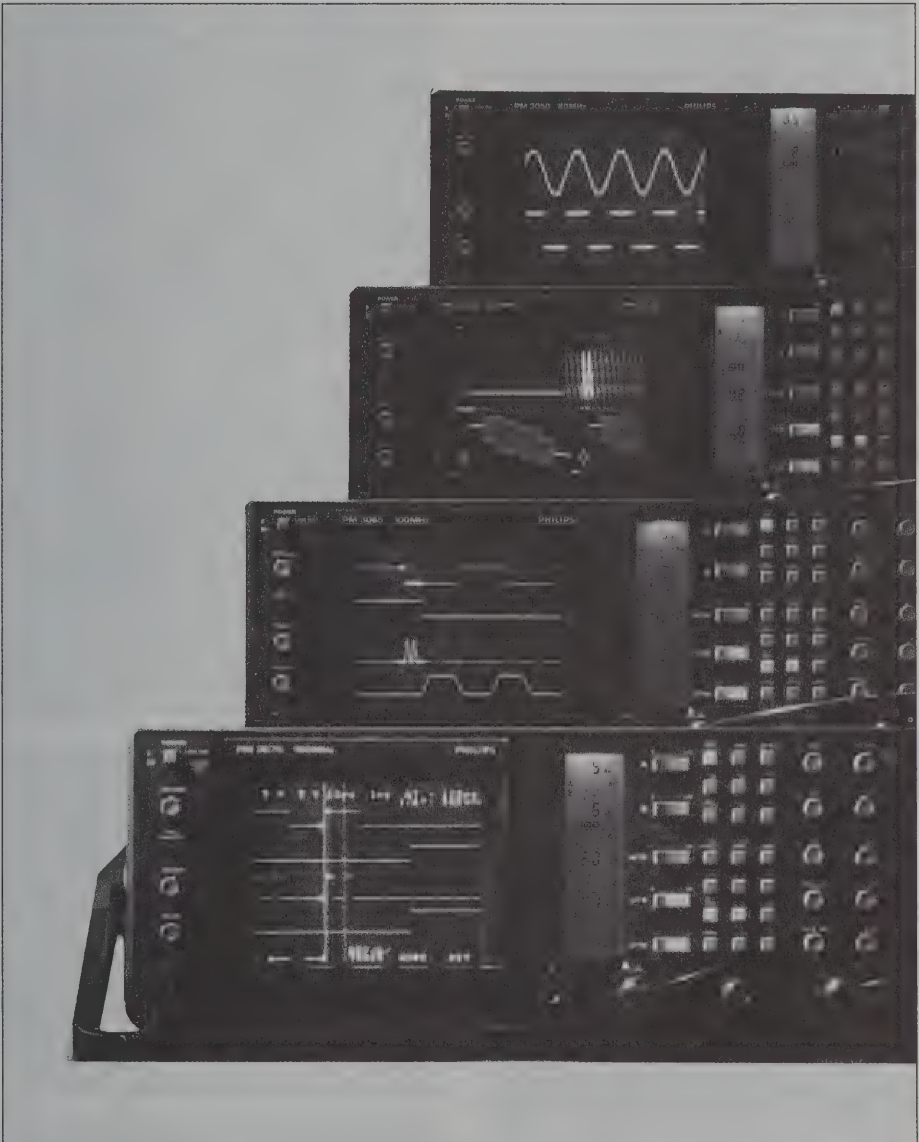
Service and Support

Three-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3050, PM 3055, PM 3065 & PM 3070

GPIB
IEEE-488



PM 3050, PM 3055, PM 3065, PM 3070

PM 3050/55 60 MHz & PM 3065/70 100 MHz Oscilloscopes

- AUTOSET for automatic amplitude,time,and trigger setting
- LCD panel displays status and settings
- 16 KV crt acceleration voltage
- Fast action up/down controls and cold switching
- GPIB/IEEE-488 interface option
- Single timebase, dual timebase and cursor versions

The New 60/100 MHz Standards

The PM 3050 to PM 3070 series of oscilloscopes set new standards in the 60 to 100 MHz oscilloscope range. A new standard in convenience and ease of use together with a new price/performance standard for instruments of this class.

The series consists of four models which are all optionally available in rackmount versions for systems use. These are;

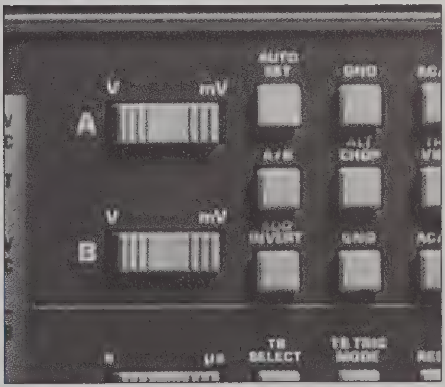
- PM 3050 60 MHz 2 channel, single time base
- PM 3055 60 MHz 2+1 channel, dual time base
- PM 3065 100 MHz 2+1 channel, dual time base
- PM 3070 100 MHz 2+1 channel, dual time base with clever cursors

Each unit represents a significant step forwards in 'scope technology through their use of microcomputer control to both speed up and simplify the task of signal measurements.

Standard features in all models include AUTOSET for single push button set up; a large backlit LCD showing all operating parameters; fast up/down rocker keys and cold switching for high reliability.

Measurements In Seconds

Just press the green AUTOSET button and automatic setting of channel amplitude, time base sweep speed and triggering takes place, for any signal. If only one channel is connected only one channel is displayed but if both channels are being used then both are automatically scaled and displayed. Triggering takes place on the lower frequency channel to give a clear jitter free display. AUTOSET eliminates time consuming manual range finding and adjustment to give fast accurate results at the touch of one button.



Just press the green AUTOSET button and automatic setting of channel amplitude, time base, sweep speed and triggering takes place, for any signal.

PM 3050, PM 3055, PM 3065 & PM 3070

Clean and Simple Operation.

With up/down rocker keys for amplitude and time base speed selection and pushbuttons for display mode and trigger source selection the operation of this series of oscilloscopes is kept clean and simple. Upon each user action the backlit LCD display is immediately updated making at a glance review of the 'scopes current parameter settings possible rather than having to search the complete front panel to determine the operating conditions.

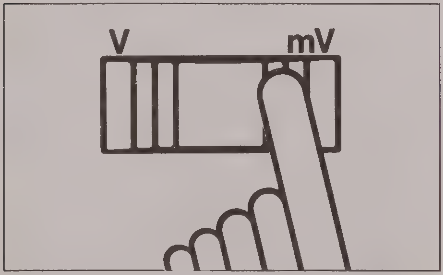
The internal microcomputer prevents illegal setups like incorrect main and delayed timebase settings and clearly identifies on the display non-calibrated amplitude settings or grounded inputs. This avoids incorrect measurements, wasted time and frustration.

To speed accurate measurements when using the delayed time base, the LCD gives a digital readout of the delay time so making the calculation of MTB sweep speed x delay time vernier redundant. For infrequent 'scope users the MENU key functions as a 'help' key showing the facilities offered by each key on the 'scope and quickly aquainting the user with its operation.

High Reliability and Easy Service

Behind the push button operation all input signals are switched by hermatically sealed long life reed relays. These keep out damp and dirt from the active signal paths and ensure long life and long term measurement stability.

The advanced modular construction of these 'scopes allows complete functional testing of each subassembly before they are built together to form a complete instrument. An extended burn in period lasting 48 hours then follows before another series of extensive tests takes place. This ensures that zero hour defects are almost completely eliminated and results in long term trouble free operation. In the unlikely event that a failure should occur the modular construction enables easy access to the suspect board without major disassembly.

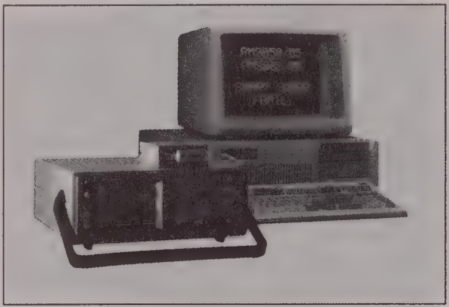


Advanced CRT

With 16 KV acceleration and advanced electron optics the CRT display has exceptional brilliance combined with a small spot size making it ideal for measurements on high speed or low repetition rate signals. The effective screen area is a full 8 x 10 cm. An internally etched graticule is provided for accurate and parallax-free measurements. Graticule illumination is standard on all models.

Fast Computer Hook Up

For systems use this Smart Scope series can be simply controlled by the GPIB/IEEE-488* bus using the PM 8953A interface. This retrofittable interface enables the 'scopes to be automatically set up for production testing or QA applications.

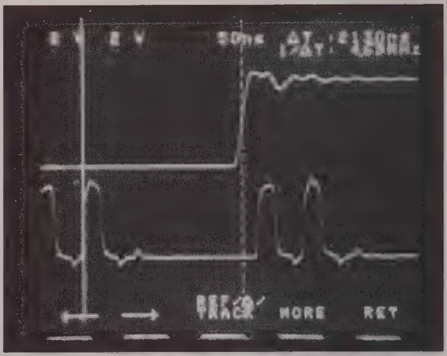


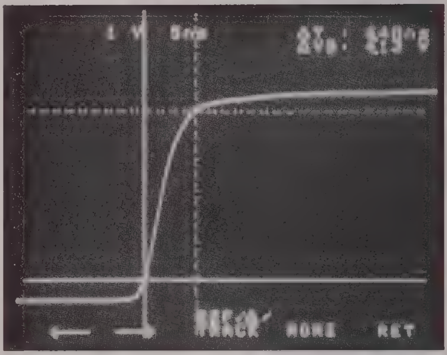
As the PM 8953A IEEE-488 interface is a separate unit which simply plugs onto the rear of the 'scope it is extremely interesting for fleet owners as it permits automatic IEEE based recalibration of the complete fleet with only one interface needing to be purchased, so saving time in recalibration, and money as well.

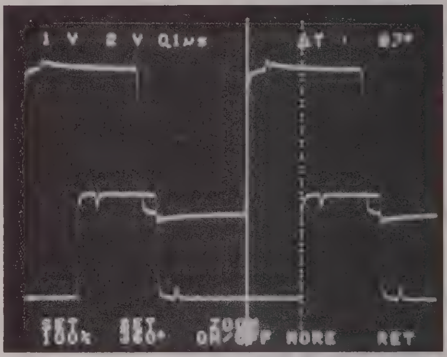
Clever Cursors

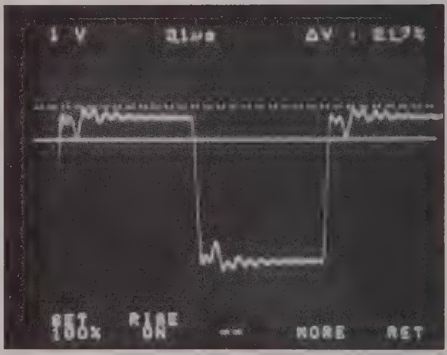
The PM 3070 offers full cursor measurement capabilities in both time and amplitude axes. Control of all cursor functions is by five keys in the bezel of the CRT which also are used to independently control the intensity of the alphanumerics and the cursor intensity. Accurate measurements of peak-peak values, voltage ratios, rise times, phase relationships and time ratios are possible with direct numerical display on the CRT.

A special facility called the ZOOM function enables the signal between the cursors to be expanded to fill the full width of the screen by automatically adjusting the delay time and delay time base speed. This makes it easy to zoom in on a particular point of interest without having to consider how to set up the delay time section. In addition to the measured data both channel and time base status is displayed on screen and user text or messages can also be specified.





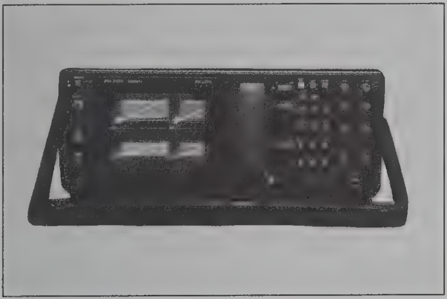




The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

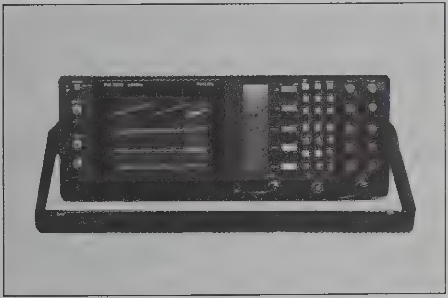
PM 3050, PM 3055, PM 3065 & PM 3070

PM 3050 60 MHz 2 Channels, SingleTime Base



With all the standard facilities of the Smart Scope series this basic instrument provides comprehensive trigger facilities like TV line, TV frame, Peak-Peak Auto and DC coupling in addition to trigger hold off. Time base speeds to 5 nsec per division are standard as well as x 1 and x 10 probe identification. X deflection via either channel is possible.

PM 3055 60 MHz 2+1 Channels, Dual Time Base

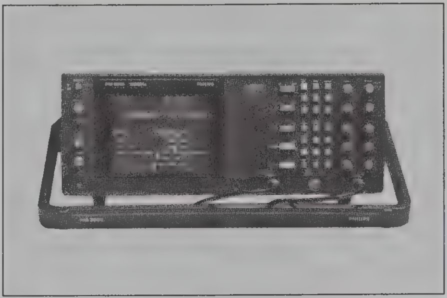


PM 3055 60 MHz oscilloscope with delayed time base and third channel trigger view.

The external trigger input of this 'scope doubles as a third input channel with a fixed attenuation. The Delayed Time Base facility can be directly triggered from the main time base or from either input channel. Display of MTB intensified and DTB is possible at the same time or independently.

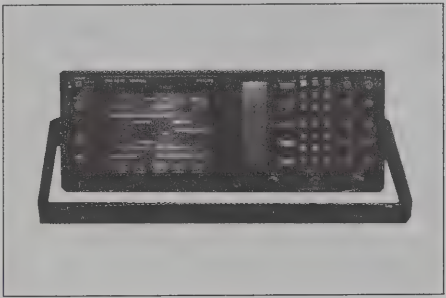
PM 3065 100 MHz 2+1 Channels, Dual Time Base

Triggering to 150 MHz plus the high intensity CRT makes this unit the ideal general purpose workhorse.The fast 3.5 nsec rise time and good pulse response characteristics make the PM 3065 the ultimate 100 MHz oscilloscope.



PM 3065 100 MHz oscilloscope with delayed time base and third channel trigger view.

PM 3070 100 MHz 2+1 Channels, Dual Time Base, Clever Cursors



PM 3070 100 MHz delayed sweep oscilloscope with clever cursors.

The Clever Cursors provide both amplitude and time measurement capabilities. In the amplitude mode peak-peak, ratio and 10% and 90% levels (for rise times) can be read directly from the display.

In the time mode rise times, ratio and phase measurements can be made and read from the display. In addition the ZOOM facility enables fast pinpointing and expansion of a specific section of the measured signal.

Specifications

Technical Specifications

Display: CRT 8 x 10 cm viewing area, P31 phosphor, 16 kV acceleration voltage. Parallax-free graticule with continuously variable illumination. Separate LCD for display of menus, settings, status indications etc. LCD is constantly illuminated by backlighting.

AUTOSET

Autoset selects proper channel, sets vertical deflection, timebase speed and triggering for easy-to-read display of input signals.

Vertical Deflection
Display Modes: Ya, Yb, - Yb, Ya + Yb, Ya - Yb, Yb
Trigger View: In any combination, chopped or alternate (not PM 3050).

Frequency Response
PM 3065/70: DC...>100 MHz -3 dB
PM 3050/55: DC...>60 MHz -3 dB (0...35°C)
(20 mV/div...10 V/div)
DC...>35 MHz -3 dB
(2 mV/div...10 mV/div)
In AC Mode: Lower -3 dB point is <10 Hz

Rise Time
PM 3065/70: <3.5 ns
PM 3050/55: <6 ns (20 mV/div...10 V/div)
<10 ns (2 mV/div...10 mV/div)
Deflection Coefficient: 2 mV/div...10 V/div in steps of 1, 2, 5 sequence
Error Limit: 3%
Continuous control between steps with > flashing in LCD as warning symbol for uncal. amplitude.
Input Impedance: 1 MΩ± 2%//20 pF ± 2 pF
Max. Rated Input Voltage: 400V (DC + AC peak)
Dynamic Range: >24 div. at 10 MHz > 8 div. at 100 MHz (PM 3065/70); 50 MHz (PM 3050/55)
CMRR: 100:1 at 1 MHz

Trigger View

Frequency Response:
PM 3065/70: DC...>100 MHz -3 dB (via ext)
DC...>75 MHz -3 dB (via Y_A or Y_B)
PM 3050/55: DC...> -3 dB (via ext 0...35°C)
DC...>50 MHz -3 dB (via Y_A or Y_B)
Deflection Coefficient: 100 mV/div. via Ext. Input 2 mV/div...10 V/div. via Ya or Yb

Horizontal Display Modes
PM 3055/65/70: MTB, MTBI, Alt TB, DTB, X-defl.
PM 3050: TB, X-defl.

Main Timebase (MTB) or Timebase (TB)

Time Coefficients: 0.5 s/div...50 ns/div. in steps of 1, 2, 5 sequence
Magnifier: x 10
Fastest Sweep Speed: 5 ns/div
Error Limit: 3%
Error Limit Magn. Sweep: 4%
Continuous control between steps with > flashing in LCD as warning symbol for uncal. sweep.
Hold-off: Continuously adjustable up to 10 x min. value

Delayed Timebase (DTB)

(not on PM 3050)
Time Coefficient: 1 ms/div...50 ns/div. in steps of 1, 2, 5 sequence
Magnifier: x 10
Fastest Sweep Speed: 5 ns/div
Error Limit: 3%
Error Limit Magn. Sweep: 4%
Trace Separation: >±4 div. DTB shift only

Delay Timebase Multiplier (DTM)

(not on PM 3050)
Resolution: 1:10,000
Error Limit Total: 4%
Delay Time Jitter: 1 ÷ 20,000

PM 3050, PM 3055, PM 3065 & PM 3070

Triggering (MTB or TB)

Trigger Modes: Auto (free run), Non Auto Triggered, Single
Trigger Sources: A, B Composite (A, B), Ext. (DC or AC), Line
LCD indicates Not triggered, Triggered or Armed status
Trigger Coupling: Peak-to-peak (P-P), DC, TVL, TVF

Triggering (DTB) (not PM 3050)

Starts, A, B, Composite (A, B), Ext. TVL (only if MTB TV selected)

Trigger Sensitivity

PM 3050/55		
	Int.	Ext.
10 MHz	0.5 div	50 mV
50 MHz	1 div	150 mV
100 MHz	3 div	500 mV
TVF/TVL	0.7 div sync.	70 mV sync.
Level range	±8 div	±800 mV

PM 3065/70		
	Int.	Ext.
10 MHz	0.5 div	50 mV
100 MHz	1.2 div	150 mV
150 MHz	2 div	500 mV
TVL/TVF	0.7 div sync.	70 mV sync.
Level range	±8 div	±800 mV

Slope pos. (_/‾), or neg. (‾_), TVF or TVL pos. (+) or neg. (-)

X-Deflection

Deflection Coefficient: Via channel A or B 2 mV/div...10 V/div.
via Ext. input 100 mV/div
Frequency Response: DC...2 MHz
Error Limit: 5%
Phase Shift: <3° (at 100 kHz)
Ext. Input: 1 MΩ ±2%//20 pF ±2 pF
Max. Input Voltage: 400V (DC + AC peak)

Cursor Measurements PM 3070
Features: V, t, 1/t
Ratio
Phase
Rise Time (4 way cursors)
Zoom
User text
Settings read-out
Intensity control independent of trace

Output Options

Y Signal out from Channel A (Not PM 3065/70)
Deflection Coefficient: 100 mV/div.; load 10 kohm 40 m/div.; load 508

Frequency Response
PM 3050/55: >60 MHz -3 dB
MTB Sweep Out: Output voltage 0.5 V/div; load 1 MΩ
MTB Gate Out: High when running MTB sweep; otherwise low; voltage output high > 2.4v; low <0.4V
DTB Gate Out: High when running MTB sweep; otherwise low; voltage output high >2.4V; low <0.4V

Check the comprehensive range of system oriented accessories for the PM 3065/PM 3070 to specify exactly the configuration you need. These options add extra functions, convenience and transportability to everyday work with your oscilloscope.

General Specifications

Power Supply

Safety requirements meet following specifications: IEC 348 Class I, UL 1244, CSA 556B, VDE 0411
Line Voltage: 100...240V ±10% in one range
Line Frequency: 50...400 Hz ±10%
DC Nominal Voltage: 145...335V

Power Consumption (AC source)
PM 3050/55: 50W
PM 3065/70: 60W

Miscellaneous
Cal. Output: 1.2V ±1%
Frequency: 2 KHz
Z-modulation Input: TTL-compatible
>2.0V blanks display
<0.8 max. intensity, analog control possible between 2.0V and 0.8V

Mechanical Data

Width
Incl. Handle: 387 mm (15.2 in)
Excl. Handle: 350 mm (13.8 in)

Length
Incl. Handle, Excl. Knobs: 518 mm (20.4 in)
Excl. Handle and Knobs: 433.5 mm (17.1 in)
Incl. Handle and Knobs: 530.5 mm (20.9 in)
Excl. Handle, Incl. Knobs: 455.7 mm (17.9 in)

Height
Incl. Feet: 146.5 m (5.8 in)
Excl. Feet: 134.5 mm (5.3 in)
Excl. Lower Cabinet: 132.5 mm (5.2 in)
Weight: Approx. 7.5 kg (16.5 lb) excl. access.

Environmental Data

Temperature
Rated Range of Use: +10°C...+40°C
Limited Range of Operation: 0°C...+50°C
Storage: -40°C...+75°C

Altitude
Operating: 15,000 ft (4,500 m)
Non-Operating: 40,000 ft (12,000 m)
Humidity: 95% RH
EMI: Meets requirements of MIL-STD-461 Class B, VDE 0871 and VDE 0875 Grenzwert- klasse B

Shock
Operating and Non-operating: 30g, 1/2 sine, 11 ms duration, 6 shocks in each direction (3 each face), for a total of 18 shocks
Vibration: 5...55 Hz, 15 minutes along each of three axes, with a maximum acceleration of 3g. Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found
Bench Handling: MIL-STD-810, method 516, procedure V
The PM 3050/55/65/70 are designed to meet the requirements of MIL-T-28800 D, Type III, Class 5, Style D.

Included with instrument: 1 set 100 MHz, 10:1 probes with 5 ft. (1.5m) cable and scale factor readout (unless noted); Blue CRT contrast filter; Operating Manual

Ordering Information

Models

January 1989 prices

PM 3050 60 MHz Oscilloscope	$1150
PM 3052 same, with Rackmount	1275
PM 3055 60 MHz Oscilloscope with 2+1 channels and delayed sweep	1350
PM 3057 same, with Rackmount	1475
PM 3065 100 MHz Oscilloscope with 2+1 channels and delayed sweep	1645
PM 3067 same with Rackmount	1770
PM 3070 100 MHz Oscilloscope with 2+1 channels, cursors and delayed sweep	1895
PM 3072 same, with Rackmount	2020

Optional Configurations

When ordering, select basic "PM" Model desired from above, and add the configuration option number listed below as a suffix.

/003 Basic Oscilloscope as listed above	N/C
/003B Basic Oscilloscope w/PM 8926 probes (only available on 60 MHz models)	less 55
/113 CRT with P7 long persistence phosphor	add 40
/703 Y Signal Output (only available on 60 MHz models)	add 75
/743 MTB Sweep + MTB gate + DTB gate outputs	add 75
/753 MTB Sweep + MTB gate + DTB gate outputs, P7 phosphor	add 115
/763 Y Signal Output (only available on 60 MHz models), plus MTB gate + DTB gate outputs	add 150
/773 Y Signal Output (only available on 60 MHz models), plus MTB gate + DTB gate outputs, P7 CRT	add 190

PM 3050, PM 3055, PM 3065 & PM 3070

Example, Ordering Configuration

To order the 60 MHz, dual timebase oscilloscope in a rackmount configuration with MTB Sweep + MTB Gate + DTB Gate Out:

	Model	Price
Oscilloscope	PM 3072	$2020
Configuration Option Suffix	/743	75
Complete Model Number	PM 3072/743	2095

Accessories (See page 53)

Passive Probes

PM 8922/501 1:1 10:1 Probe, cable length 4 ft. (1.2m)	$ 50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8924/20 1:1 Probe, cable length 8 ft (2.5m)	60
PM 8926 10:1 Passive Probe, cable length 5 ft (1.5m)	70
PM 8926/09 10:1 Passive Probe with readout, cable length 5 ft (1.5m)	80
PM 8926/501 10:1 Probe, cable length 4 ft (1.2m)	$50
PM 8926/591 10:1 Probe with readout, cable length 4 ft (1.2m)	60
PM 8926/29 10:1 Passive Probe with readout, cable length 8ft (2.5m)	80
PM 8931/09 20 MΩ, 100:1 Passive Probe with readout	135
PM 8936/09 Set of 2 PM 8926/09	125

Active Probes

PM 8940/09Q High Voltage Isolation Amplifier with readout	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe with readout	1000

Other Accessories

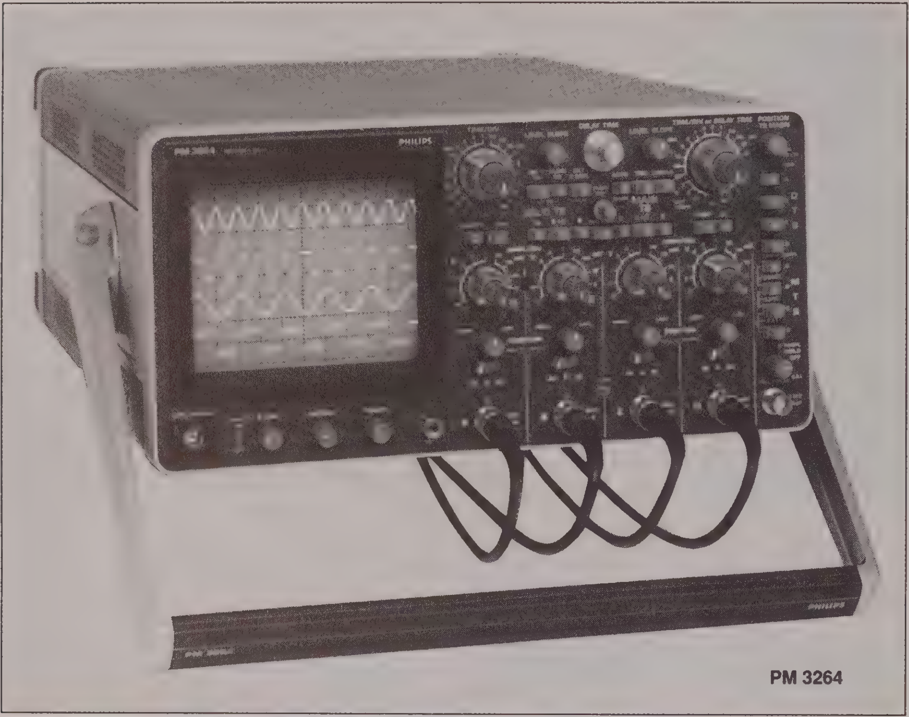
PM 8901Q Rechargeable Battery Pack	1275
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8953A External, retrofittable GPIB IEEE-488 I/F	$550
PM 8988 Protective Front Panel Cover	35
PM 8991/04 Oscilloscope Cart	450
PM 8999 Oscilloscope Stand	250
PM 8992/80 Accessory Pouch	45
PM 8998 Front panel memory for PM 3050...70	75
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9381 Oscilloscope Camera	650
PM 2195/09 Probe switch	650
PM 2122/01 50Ω Coaxial Switch	680

Service & Support

Three year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3264



PM 3264

PM 3264 100 MHz Four-Channel Oscilloscope

- Fifth channel trigger view
- Advanced display facilities for realtime analysis up to 100 MHz
- Multi-source triggering
- Simultaneous display of MTB and DTB
- Portable with battery operation for field use

The PM 3264 offers a unique solution to many timing problems in digital electronics. Simultaneous display of 4 or 5 input signals provides a quick and convenient method for realtime analysis of digital signals both at component and system level.

A versatile deflection system provides many user-benefits. For example, any combination of up to five input signals and two different modes can be selected by push-buttons. The sensitivity of the channels includes 2 mV/div up to 400V per screen, using the standard 1:10 attenuator probes.

A flexible triggering system allows the main and delayed time bases to be triggered independently by any of the four input channels. Also, an external trigger and composite trigger are provided.

The alternate time base facility permits a quick reference for magnified displays with respect to the original waveform. The multiple trace display demands a CRT with very high light output. Philips has designed a special tube with 17 kV pda which provides a more-than-adequate sharp, bright, spot.

With all the foregoing facilities, the PM 3264 remains a typically compact, portable, oscilloscope which is also extremely simple to use. The various facilities are summarized as follows:

- Four channels to show signal relationships in time
- Multi-source triggering to add display flexibility
- Trigger-view to relate triggering directly to the four-channel display
- Other features like differential displays and composite triggering to extend performance
- Two time bases to allow signal detail to be packed out from the data stream
- Alternative time base mode to allow signal details to be directly related to data stream

Moreover, facilities can be permutated, with virtually no limitation. For example, main and delayed time bases can be independently triggered from any of the four channels. Or the alternate time base mode can be employed with a differential display and the original four channels to give a 12-trace display.

Trigger View

PM 3264 features the ultimate in multi-sourced triggering, with independent selection of main and delayed time bases from any of the four channels plus composite, line and external triggering on the main time base. It is therefore essential that the relationship between the various displays and the triggering signal is always clear and this is provided by the trigger view facility. At the touch of a button the actual trigger signal is displayed as a “fifth” channel, so that there can be no possibility of display ambiguity.

Alternate Time Base Mode

This mode is obtained simply by pushing both the main and delayed time base controls together. It enables the delayed time base signal details to be displayed at the same time as the intensified main time base signals. In this way signal details can be directly related to the data stream.

X-Y Displays

X-Y displays are further evidence of the advanced display capability of the PM 3264. The independent triggering facilities allow any one of four channels to be displayed against an X-input signal or against any of the four vertical input.

Composite Triggering

Single-channel triggering shows the exact relationship between the displayed signals. Composite triggering, however, allows signals that are not related in time or phase to be displayed and compared. This facility can be used in a variety of ways, for example rise times or waveform aberrations can be compared and measured regardless of the time span between signals or the frequency relationship.

Logic Triggering Too

The PM 3264 is the ideal compliment to a logic analyzer since it shows realtime relationships and signal details, such as glitches, in their actual analog waveform.

Very Easy Operation

PM 3264 is a highly sophisticated instrument but the front panel could not possibly be simpler or more logical. Channel selection is made, for example, directly above the relevant channel controls. Trigger selection for main and delayed time bases is also logically grouped. This simplifies and speeds up measurements and allows the oscilloscope to be used for virtually all applications and production testing.

In addition the PM 3264 is light, easy to transport and hence ideal for field work, a facility that can be extended via the optional battery pack.

PM 3264

Specifications

Technical Specifications

CRT

Type: Philips rectangular domed mesh-type tube with 17 kV acceleration potential and metal-backed phosphor
Screen Type: P31 (GH phosphor standard)
Useful Screen Area: 8 x 10 div. of full centimeters
Graticule: Internal graticule with centimeter divisions and 2 mm subdivisions along the central axes. 10% and 90% lines are indicated. Illumination continuously variable.

Vertical or Y-Axis, Channels A thru D

Response
DC: 0 Hz...100 MHz (35 MHz at 2 mV)
AC: 7 Hz...100 MHz
Rise Time: 3.5 ns
Deflection Coefficients: 2 mV...5V/div. in steps in 1-2-5 sequence. Uncalibrated continuous control between steps 1: >2.5
Display Modes: Channel A, B, C or D; A + B, C + D; Trigger view; Any combination of these channels.
Multiple display chopped at 1 MHz or alternate. Any channel may be inverted except Trigger view.
CMMR: >100:1 up to 2 MHz; >20:1 at 50 MHz
Input Impedance: 1 MΩ ±2% in parallel with 15 pF approx. RC time, AC coupled: 22 ms
Maximum Input Voltage: 400V_{DC} + AC_{pk}, derating above 500 kHz
Maximum Deflection: Undistorted deflection of 24 div. up to 35 MHz Shift range 16 div.
Signal Delay: 15 ns visible delay

Trigger View
Display: External or internal trigger signal
Deflection Coefficient External: 100 mV/div
Trigger Point: Screen center ±0.3 div.
Time Delay Between Vertical Input and External Input: 3 ns

Horizontal or X-Axis

Horizontal deflection can be obtained from either the main time base or the delayed time base or a combination of the two, or from the signal source selected for X-deflection.
In this case X-Y diagrams can be displayed using A, B, C, or D the Ext connector or the Line as a signal source.

Horizontal Display Modes:
- Main time base
- Main time base intensified by delayed time base
- Delayed time base
- Main time base and delayed time base simultaneously displayed (alternate)
- X-Y operation with X-deflection by A, B, C, D line or Ext source

Horizontal Amplifier

Response: DC...2 MHz (-3 dB)
Deflection Coefficient: 50 mV/div. using EXT connector. Uncalibrated continuous control 1: >3. When A, B, C, or D are used, sensitivity is 2 mV...5V/div.
Measuring Accuracy: ±3%
Phase Error: 3° at 100 kHz

Main Time Base Modes

- Auto
- Triggered (RC time 100 ms)
- Single shot

Time Coefficient: 1s...50 ns/div. in 23 calibrated steps, in 1-2-5 sequence. Uncalibrated continuous control between steps (with UNCAL warning lamp should delayed time base be set out of calibration). x 10 magnifier extends max. sweep rate to 5 ns/div.
Accuracy: ±2% (+20°C...+30°C); ±3% (+5°C...+40°C); Additional error for magnifier ±1%
Variable Hold-Off: Sweep hold-off time can be increased by a factor of 10

Delayed Time Base

Modes: Delayed time base starts, either immediately after the delay time or, upon arrival of the first trigger pulse after the delay time.
Time Coefficients: 0.5s...50 ns/div. in 22 calibrated steps, 1-2-5 sequence. Uncalibrated continuous control between steps, (with UNCAL warning lamp should main time base be set out of calibration). x 10 magnifier extends max. sweep rate to 5 ns/div.
Accuracy: ±2% (+20°C...+30°C); ±3% (+5°C...+40°C); Additional error for magnifier ±1%
Calibrated Sweep Delay: Continuous calibrated control between 0 and 10 x main time base setting
Incremental Delay Time Accuracy: 0.2% typical
Delay Time Jitter: Better than 1:30 000

Main Time Base Triggering

Trigger Source: Internal A, B, C, D Composite, line External
Slope: + or -
Level Range: Internal: 24 div.
External: +1.2V to -1.2V

Trigger Sensitivity

	30 MHz	100 MHz
Int	0.5 div	1.5 div
Ext	50 mV	150 mV

Trigger Coupling
DC: DC...full bandwidth
AC: 100 Hz...full bandwidth
Ext. Trigger Input Impedance: 1 MΩ ±2% in parallel with 15 pF approx.
Maximum Allowable Input Voltage: 400V_{DC} + AC_{pk}
Trigger Jitter: Better than 0.5 ns

Delayed Time Base Triggering

Trigger Source: Internal: A, B, C, or D; For Slope, Level range and Sensitivity see Main Time Base Triggering

Calibration

Calibrated Voltage: 3V_{p-p} ±1% square wave
Calibrated Current: 6 mA_{p-p} ±2% square wave

Z-Modulation

Input: DC-coupled, TTL compatible, "HIGH" level blanks the display
Input Impedance: 10 kΩ
Maximum Input Voltage: 50V
Response Time: 35 ns

Power

Line Voltages and Frequencies
AC: 100...127V and 220...240V, 46...440 Hz
DC: 250...350V
Power Consumption: 50W at nominal line voltage
Dimensions: 316 mm W x 154 mm H x 460 mm L (12.4 in W x 6.1 in H x 18 in L)
Weight: 11 kg (24 lb)

Environmental Capabilities

Ambient Temperatures
Rated Range of Use: +5°C to +40°C
Limits for Operation: -10°C to +55°C
Storage and Transport: -55°C to +75°C

Altitude
Operating: to 5000m (15 000 ft)
Non-Operating: to 15 000m (45 000 ft)
Humidity: 21 days cyclic damp heat 25°C...40°C R.H. 95%
Shock: 30g: half sinewave shock of 11 ms duration: 2 shocks per direction for a total of 12 shocks
Vibration: Vibrations in three directions with a maximum of 15 min per direction; 5...55 Hz and amplitude of 0.7 mmp-p and 4g max. acceleration. Unit mounted on vibration table without shock absorbing material.
Recovery Time: Operates within 30 minutes coming from -10°C soak, going into 60% relative humidity at +20°C room conditions
Electromagnetic Interference: Meets VDE 0871 and VDE 0875 (Grenzwertklasse B)
Safety: Safety class I according to IEC 348

Included With instrument: Front cover with storage space, operating and service manual, BNC-banana adapter, contrast filter, 4 x10:1 attenuator probes, collapsible viewing hood and cal terminal - BNC adapter.

PM 3264

Ordering Information

Model

January 1989 prices

PM 3264Q 100 MHz 4-Channel Oscilloscope with trigger view	$4600

Accessories (Also see page 53)

Passive Probes

PM 8922/501 1:1 or 10:1 Probe, cable length 4 ft (1.2m)	50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8926 10:1 Passive Probe, cable length 5 ft (1.5m)	70
PM 8926/501 10:1 Probe, cable length 4 ft (1.2m)	$50
PM 8926/20 10:1 Passive Probe, cable length 8 ft (2.5m)	70
PM 8931/00 20 mΩ, 100:1 Passive Probe	125

Active Probes

PM 8940/09Q High Voltage Isolation Amplifier	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe	1000

Other Accessories

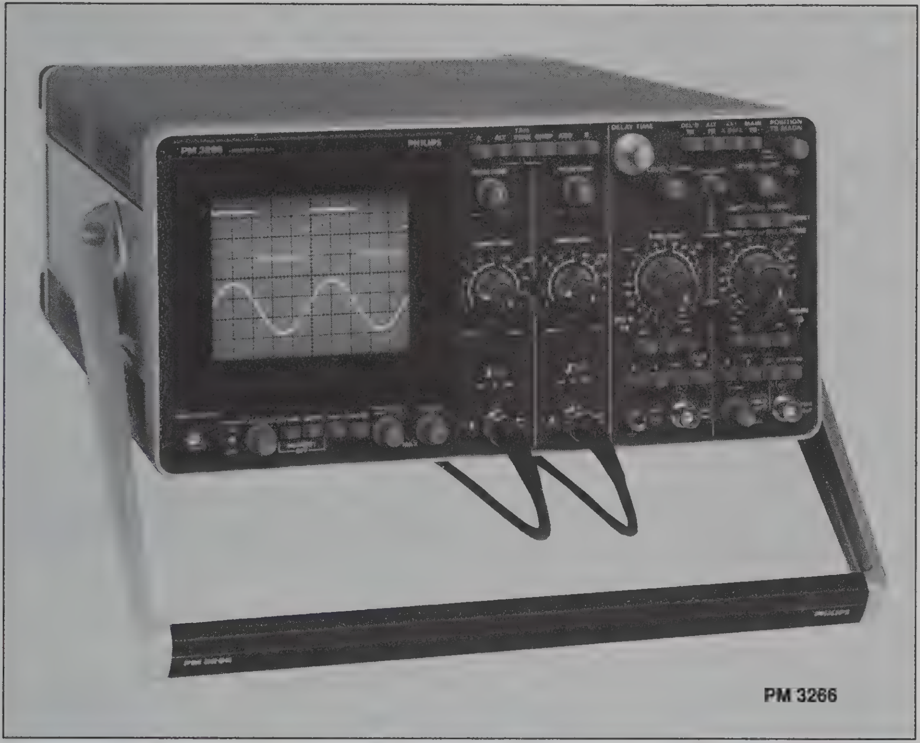
PM 8901Q Rechargeable Battery Pack	1275
PM 8910 Anti-Glare Filter	35
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8960/03 Rackmount Adapter	$250
PM 8976 Camera Adapter for stationary use	100
PM 8991/04 Oscilloscope Cart	450
PM 8992/66 Accessory Pouch	45
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9366 Collapsible Viewing Hood	20
PM 9381 Oscilloscope Camera	650

Service and Support

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3266



PM 3266 100 MHz Transfer Storage Oscilloscope

- 100 MHz/5 mV (2mV at 35 MHz)
- 1000 div/µs writing speed over full screen
- Adjustable background lighting level
- Auto erase with variable viewing times
- Storage times up to 1h
- Alternate time base display
- Trigger view usable as a third channel

The PM 3266 will capture repetitive or single high-speed events and store them for viewing, for up to 1 hour. Storage time is continuously variable from 15 seconds minimum. The two different storage modes include a fast mode utilizing a writing speed of 1000 div/µs, and a write mode with a 0.25 div/µs writing speed. A max. write position is included in the write mode circuit to provide a 2.5 div/µs writing speed.

A variable control allows optimum setting of the contrast between the oscillogram and screen background when operating in the fast mode.

In fast mode for repetitive signals, an auto erase facility refreshes the signal being observed allowing variable viewing times between 3 and 8 seconds.

Typical applications include observation, using the single shot mode of, e.g., various phenomena in discharge tubes, relays, etc. Also in digital systems the PM 3266 will capture glitches which occur randomly as interference signals.

Measurement accuracy has been increased to a high order by the extremely sensitive storage system combined with full screen display. Moreover operation of the various facilities has been made very easy. Controls are reduced to one variable control pluus a single push-button for each function (i.e. four push- buttons only).

Other facilities include alternate time base display plus composite triggering capability to allow the display of non time-related signals; the wide band trigger circuit operates well beyond the 100 MHz vertical bandwidth.

The trigger view system can also be used as a third display channel and vertical sensitivity ranges from 2 mV (up to 35 MHz) through 5 mV to 5V (at 100 MHz).

Specifications

Technical Specifications

CRT

Type: Philips high speed image transfer storage tube with scan magnification in vertical direction. Rectangular tube face, post accelerator and metal-backed phosphor
Screen: P31 (GH) phosphor
Acc. Voltage: 10 kV
Useful Screen Area: 8 x 10 div, each div equals 0.9 cm
Graticule: Internal with subdivisions along central axes. 10% and 90% lines are indicated

Writing Speed

Fast: 1000 div/µs
Max. Write: 2.5 div/µs
Write: 0.25 div/µs (measured after erasure) Lower writing speeds at higher contrast level can be adjusted
Storage Time: Up to 1 hour, in store mode depending on intensity setting. At max. intensity:
Fast: 15s
Max. Write: 15s
Write: 60s
Auto Erase: In fast mode. View time continuously variable between 3 and 8s
Persistence: In Write mode, continuously variable between 0.3 and 60s
Erasure Time: 1.3s in Write mode; 1.6s in Fast mode

Vertical or Y-Axis

Response
DC: 0 Hz...100 MHz (35 MHz at 2 mV)
AC: 7 Hz...100 MHz
Rise Time: 3.5 ns
Deflection Coefficients: 2 mV...5V/div. in steps in 1-2-5 sequence. Uncalibrated continuous control between steps 1:>2.5
Accuracy: ± 3%
Display Modes:
Channel A only
Channel B only
Alternate
Chopped at approx. 1 MHz
Channels A and B added
Trigger view
Trigger view with channels A and B alternate
Trigger view with channels A and B chopped
Channels A and B can be inverted
CMMR: >100:1 up to 2 MHz; >20:1 at 50 MHz
Input Impedance: 1 MΩ ±2% in parallel with 15 pF approx. RC time, AC coupled: 22 ms
Maximum Input Voltage: 400V DC-AC$_{pk}$ derating above 500 kHz
Maximum Deflection: Undistorted deflection of 24 div up to 35 MHz. Shift range 16 div
Signal Delay: 15 ns visible delay

Trigger View

Display: External or internal trigger signal
External: 100 mV/div

PM 3266

External ÷ 10: 1V/div
Trigger Point: Screen center ± 0.3 div
Time Delay Between Vertical Input and External Input: 3 ns

Horizontal or X-Axis

Horizontal deflection can be obtained from either the main time base or the delayed time base or a combination of the two, or from the signal source selected for X-deflection. In this case X-Y diagrams can be displayed using Y_A, Y_B, the Ext connector or the Line as a signal source.
Horizontal Display Modes:
Main time base
Main time base intensified by delayed time base
Delayed time base
Main time base and delayed time base simultaneously displayed (alternate)
X-Y of X-Y/Y operation with X-deflection by Y_A, Y_B, Line or Ext source

Horizontal Amplifier

Response: DC≥2 MHz (-3 dB)
Deflection Coefficient: 50 mV/div using Ext connector and 500 mV/div in Ext 10 switch position. Uncalibrated continuous control 1:>3. When Y_A, or Y_B, are used, sensitivities are 2 mV...5V/div
Measuring Accuracy: ± 3% (Ext. X-input)
Phase Error: 3° at 100 kHz

Main Time Base

Modes:
Auto, RC time 100 ms
Triggered
Single shot
Time Coefficients: 1s...50 ns/div in 23 calibrated steps, in 1-2-5 sequence. Uncalibrated continuous control between steps, (with UNCAL warning lamp should main time base be set out of calibration). x 10 magnifier extends max. sweep rate to 5 ns/div
Accuracy: ± 2% (+20°C...+30°C); ± 3% (+5°C...+40°C); Additional error for magnifier ± 1%
Variable Hold-Off: Sweep hold-off time can be increased by a factor of 10

Delayed Time Base

Modes: Delayed time base starts, either immediately after the delay time or, upon arrival of the first trigger pulse after the delay time
Time Coefficients: 0.5s...50 ns/div in 22- calibrated steps, 1-2-5 sequence. Uncalibrated continuous control between steps (with UNCAL warning lamp should delayed time base be set out of calibration). x 10 magnifier extends max. sweep rate to 5 ns/div
Accuracy: ± 2% (+20°C...+30°C); ± 3% (+5°C...+40°C); Additional error for magnifier ± 1%
Calibrated Sweep Delay: Continuous calibrated control between 0 and 10 x main time base setting
Incremental Delay Time Accuracy: 0.2 % typical
Delay Time Jitter: Better than 1:30 000

Main Time Base Triggering

Trigger Source: Internal Y_A, Y_B, Composite, Line External, External ÷ 10
Slope: + or -

Level Range

Internal: 24 div
External: +1.2V to -1.2V
External ÷ 10: +12V to -12V

Trigger Sensitivity

	Int	Ext	Ext ÷ 10
30 MHz	0.5 div	50 mV	500 mV
100 MHz	1.5 div	150 mV	1.5V

Trigger Coupling

DC: DC...full bandwidth
HF: 30 kHz...full bandwidth
LF: Internal 0...30 kHz; External 7 Hz...30 kHz
Ext. Trigger Input Impedance: 1 MΩ ± 2% in parallel with 15 pF approx.
Maximum Allowable Input: 400V DC-AC_{pk}
Trigger Jitter: Better than 0.5 ns

Delayed Time Base Triggering

Trigger Source: Internal: Y_A or Y_B; External; Other characteristics are identical to Main Time Base Triggering

Calibration

Calibrated Voltage: 3V_{p-p} ± 1% square wave
Calibrated Current: 6 mA_{p-p} ± 2% square wave

Z-Modulation

Input: DC-coupled, TTL compatible, "HIGH" level blanks the display
Input Impedance: 10kΩ
Maximum Input Voltage: 50V
Response Time: 35 ns

Power

Line Voltages and Frequencies
AC: 100...127V and 200...240V, 46...440 HHz
DC: 250...350V
Power Consumption: 50W at nominal line voltage
Dimensions and Weight: 316 mm W x 154 mm H x 460 mm L (12.4 in W x 6.1 in H x 18 in L) 10.9 kg (23.9 lb)

Environmental Capabilities

Ambient Temperatures
Rated Range of Use: +5°C to +40°C
Limits For Operation: -10°C to +55°C
Storage and Transport: -55°C to +75°C
Altitude: Operating: to 5000m (15 000 ft); Non-operating: to 15 000m (45 000 ft)
Humidity: 21 days cyclic damp heat 25°C...40°C R.H. 95%
Shock: Operating: 30g, half sine, 11 ms duration, 2 shocks per axis per direction for a total of 12 shocks
Vibration: Vibrations in three directions with a maximum of 15 min per direction; 5...55 Hz and amplitude of 0.7 mm_{p-p} and 4g max. acceleration. Unit mounted on vibration table without shock absorbing material
Recovery Time: Operates within 30 min coming from -10°C soak, going into 60% relative humidity at +20°C
Electromagnetic Interference: Meets VDE 0871 and VDE 0875 (Grenzwertklasse B)
Safety: Safety class 1 according to IEC 348
Included: Front cover with storage space; operating and service manual; BNC-banana adapter; contrast filter; 2 x 10:1 attenuator probe PM 8928/00; collapsible viewing hood; cal terminal-BNC adapter
Included with instrument: 2 passive 10:1 probes, Blue CRT contrast filter, Front cover with accessory storage compartment, Operating and Service Manual, Collapsible viewing hood, BNC-banana adapter; cal terminal-BNC adapter.

Ordering Information

Model

January 1989 prices

PM 3266Q 100 MHz Oscilloscope	$7700

Accessories (See page 53)

Passive Probes

PM 8922/501 1:1 Probe, cable length 4 ft (1.2m)	50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8926 10:1 Probe, cable length 5 ft (1.5m)	70
PM 8926/20 10:1 Probe, cable length 8 ft (2.5m)	70
PM 8926/501 10:1 Probe, cable length 4 ft (1.2m)	50
PM 8931/00 20 MΩ, 100:1 Probe	125

Active Probes

PM 8940/09Q High voltage Isolation Amplifier	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe	1000

Other Accessories

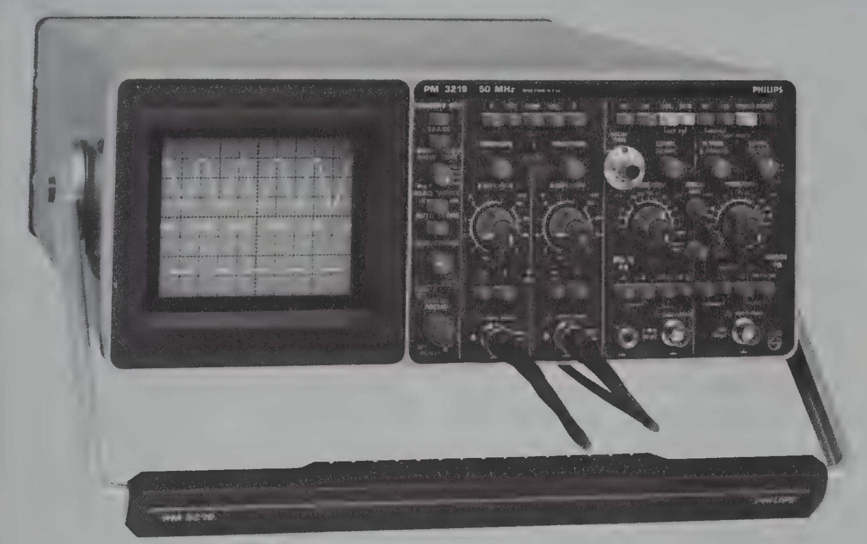
PM 8901Q Rechargeable Battery Pack	1275
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8960/03 Rackmount Adapter	250
PM 8976 Camera adapter for stationary use	100
PM 8991/04 Oscilloscope Cart	450
PM 8992/66 Accessory Pouch	45
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9366 Collapsible Viewing Hood	20
PM 9381 Oscilloscope Camera	650

Service & Support

One-year product warranty. See page 470 for further information on warranty terms and conditions.

The above configurations meet North American power requirements. For other power options, see page 491.

PM 3219



PM 3219

PM 3219 50 MHz Analog Storage Oscilloscope

- 2 mV sensitivity at 50 MHz
- Auto erase between 1 and 10s
- Auto store up to 24 hours in 'babysit' mode
- Dual slope triggering
- Ergonomic design
- Operation from most voltage/frequency line supplies and 21...30 Vdc

The PM 3219 has been designed to provide comprehensive, cost-effective storage of single-shot transients, low-frequency phenomena and other signals. It combines sophisticated facilities such as a 'babysit' mode and auto erase with an excellent 50 MHz specification. The unique storage facilities provide a wealth of capture and display possibilities.

Variable Persistence and Storage

The PM 3219 combines the dual advantages of variable persistence and variable storage. This allows, for example, low frequency signals to be displayed without flicker and also gives clear displays of fast pulses with low repetition rates.

Its use effectively adds a 'tail' to a slow-moving signal and thereby gives a continuous, flicker-free display. The persistence control allows the timing of this tail to be adjusted between 0.5s and 0.5 min. Storage time is also adjustable: signals can be retained and viewed for one minute at maximum brightness or for one hour at minimum brightness.

When the instrument's variable persistence and storage facilities are not employed, the PM 3219 can be used for a wide range of analog and digital measurement applications.

The 'Babysit' Mode

In this mode the instrument can capture either positive or negative going transient signals and store the results within a 24 hour monitoring period, without operator attendance. It is therefore possible to display and analyze transient events that have occcurred overnight, during the following morning.

Auto Erase Facility

Repetitive, low-frequency events are difficult to display. Setting the viewing time to coincide with the repetition time enables events to be captured and displayed one after another. Such a setting results in a virtually continuous signal of the events, but any change is seen immediately and if necessary that particular signal can be captured for a longer analysis simply by pushing the 'read' button before the next erase action occurs.

Specifications

Technical Specifications

CRT

Type: Philips rectangular mesh type post deflection accelerator tube with 8.5 kV accelerating voltage, half-tone storage
Screen: P31 phosphor, metal-backed
Useful Screen Area: 8 x 10 divisions of 0.9 cm
Graticule: Internal graticule

Persistence

Normal: Natural persistence of P31 phosphor
Variable: Continuously variable from ≤0.5s to ≥1 min

Storage Time

In 'Write' Mode: ≥1 min
In 'Read' Mode: ≥1h
In 'Auto Store' Mode: 24h

Writing Speed

Normal: ≥0.2 div/µS
Max. Write: ≥2 div/µS

Erase

Push-button Operated: Erasure time ~ 1.3s
Automatic: View time can be set between 1s and 10s. Scope automatically switches to single sweep operation
Auto Store: Scope is automatically switched to single sweep operation and stores a single shot

Vertical or Y-Axis

Frequency Response
DC: 0 Hz...50 MHz (-3 dB)
AC: 2 Hz...50 MHz (-3 dB)
Rise Time: 7 ns
Deflection Coefficients: 2 mV/div. 1-2-5 sequence. Uncalibrated, continuous control between steps 1:>2.5
Accuracy: ± 3% (auto store ± 5%)
Display Modes: Channel A, channel B, alternate, chopped at approx. 500 kHz, added. Channel B can be inverted
Input Impedance: 1 MΩ//20 pF
Maximum Input Voltage: 400V (DC + AC pk)
Maximum Deflection: Undistorted deflection of 24 div; Shift range 16 div
Signal Delay: Viewing of leading edge possible
CMRR-Factor: 100:1 at 1 MHz (A-B mode with 8 div common mode signal)

Horizontal or X-Axis

Horizontal deflection can be obtained from the main time base, the delayed time base, a combination of both, or from an external source. In this case X-Y diagrams can be displayed using Y_A, Y_B, the EXT connector or the mains as signal source for horizontal deflection.
Display Modes: X-Y of X-Y/Y operation with X-deflection by Y_A, Y_B, External or Line

PM 3219

X-Input

Deflection Coefficients: 200 mV/div using EXT connector; 2V/div using EXT ÷ 10 connector; Vertical attenuator coefficients apply when Y_A, or Y_B is used for X-deflection
Measuring Accuracy: ± 10%
Frequency Response: DC...1 MHz (-3 dB)
Phase Error: 3° at 100 kHz

Main Time Base

Mode: Automatic, triggered or single shot
Time Coefficients: 0.5s/div...100 ns/div in 1-2- 5 sequence. Uncalibrated, continuous control between steps 1:>2.5; x 10 magnifier extends max. sweep rate to 10 ns/div
Accuracy: ± 3%
Additional error for magnifier ± 2%

Delayed Time Base

The delayed time base either starts immediately after the delay time, or is triggerable after delay time by the selected delayed time base trigger source
Time Coefficient: 1 ms/div...100 ns/div in 1-2- 5 sequence. Uncalibrated continuous control between steps 1:>2.5
Accuracy: ± 3%
Sweep Delay: Variable in steps with main time base. Continuously variable with 10-turn potentiometer between 0.1x and 9.9x the time coefficient of the main time base
Incremental Delay Time Accuracy: 0.5%
Delay Time Jitter: 1:≥20 000

Main Time Base Triggering

Trigger Source: Internal Y_A, Y_B, Composite, Line External; External ÷ 10
Slope: + or - (full bandwidth) dual; 0...10 MHz

Trigger Modes

Auto: 20 Hz...50 MHz
DC: 0 Hz...50 MHz
AC: 5 Hz...50 MHz

Trigger Sensitivity

Internal: 1 div at 50 MHz
External: 200 mV at 50 MHz
External ÷ 10: 2V at 50 MHz

Level Range

Internal: ≥16 div
External: ≥3.2V
External ÷ 10: ≥32V
Automatically adjusted between limits of signal amplitude in position Auto

Variable Hold-Off: Continuously variable trigger hold-off
External Trigger Input Impedance: 1 MΩ//20 pF

Delayed Time Base Triggering

Trigger Source
Internal: Y_A, Y_B, Composite: Int. 2 div at 50 MHz; Ext. 400 mV at 50 MHz
Trigger Sensivity: 2 div at 50 MHz; Other trigger specifications of the delayed time base are identical to that of the main time base

Calibration

Voltage: $1.2V_{pp}$ ± 1% square wave
Frequency: 2 kHz

Power Requirements

Line Voltages and Frequencies: 110, 220 and 240VAC ± 10%, 50...400Hz ± 10%
DC Power Source: 21...30VDC, floating input, 1.5A max.
Power Consumption: 40W when powered from nominal line voltage
Z-Modulation: TTL compatible; "0" blanks the display
Dimensions: 335 mm W x 137 mm H x 470 mm L (13.2 in W x 5.4 in H x 18.5 in L)
Weight: 10 kg (22 lb)

Environmental Capabilities

Ambient Temperatures
Rated Range of Use: +5°C...+40°C
Limits for Operation: -10°C...+55°C
Storage and Transport: -40°C...+70°C
Altitude: Operating to 5000m (15 000 ft);
Non-operating: to 15 000m (45 000 ft)
Humidity: 21 days cyclic damp heat 25°C...40°C, RH 95%
Shock: 30g: half sinewave shock of 11 ms duration; 3 shocks per direction for a total of 18 shocks
Vibration: Vibrations in three directions with a maximum of 20 min per direction; 10 min with a frequency of 5...25 Hz and amplitude of 1.016 mm_{pp}; 10 min with a frequency of 25... 55 Hz and an amplitude of 0.5 mm_{pp}.
Maximum acceleration 3g. Unit mounted on vibration table without shock-absorbing material
Recovery Time: Operates within 30 min, coming from -10°C soak, going into room conditions of 60% RH at 20°C

Included with instrument: Front cover; 2 x BNC — 4 mm banana adapter; 2 x 10:1 passive probes PM 8926/001, 4 mm banana adapter, Operating manual

Ordering Information

Model	January 1989 prices
PM 3219U 50 MHz variable persistence Analog Storage Oscilloscope	$5250

Accessories (See page 53)

Passive Probes	
PM 8922/501 1:1 or 10:1 Probe, cable length 4 ft (1.2 m)	50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8926 10:1 Passive Probe, cable length 5 ft (1.5m)	70
PM 8926/20 10:1 Passive Probe, cable length 8 ft (2.5m)	70
PM 8926/501 10:1 Probe, cable length 4 ft (1.2m)	50
PM 8931/00 20 MΩ, 100:1 Passive Probe	125
Active Probes	
PM 8940/09Q High voltage Isolation Amplifier	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe	1000
Other Accessories	
PM 8901Q Rechargeable BatteryPack	1275
PM 8905 12 Vdc Power Converter	250
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8965/03 Rackmount Adapter	175
PM 8972 Camera adapter for stationary use	85
PM 8991/04 Oscilloscope Cart	450
PM 8992/15 Accessory Pouch	45
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9366 Collapsible Viewing Hood	20
PM 9381 Oscilloscope Camera	650

Service & Support

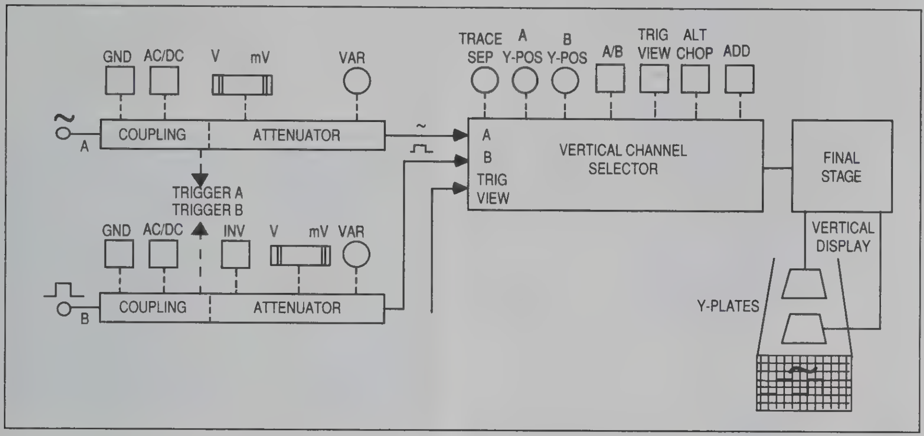
One-year product warranty. See page 470 for more information on warranty terms and conditions.

Note:The above configurations meet North American power requirements. For other power options, see page 491.

Digital Storage Oscilloscopes

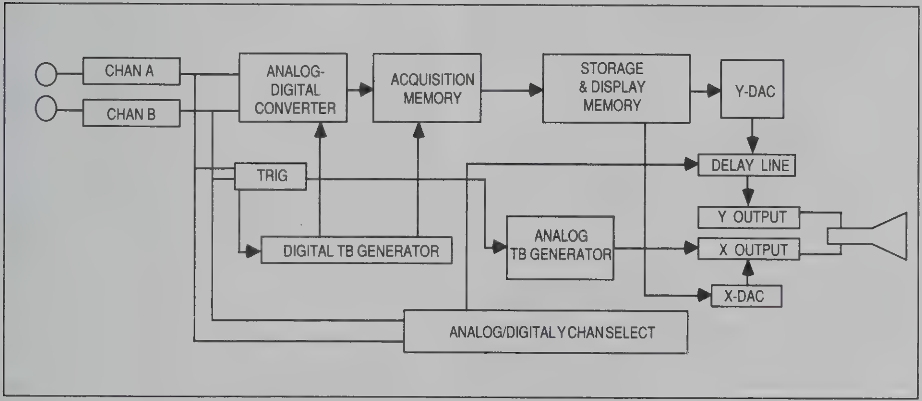
Digitizing - A block diagram

The functional block diagram of a digitizing oscilloscope shows many differences with the analog instrument. The block diagram of an analog scope is basically very simple: Input circuitry, attenuators, preamplifiers, channel switch, delay line, and output amplifier for vertical deflection, trigger selection trigger circuits, time-base(s) and horizontal output amplifier. (Plus, of course, the power supply and CRT.)



In a digital storage oscilloscope, or DSO, the input circuitry plays essentially the same signal conditioning role as in an analog scope, and is often constructed similarly. Because of the different triggering behavior of a DSO, a delay line is not required.

Digital Storage Oscilloscopes have a normal analog oscilloscope-type front end with attenuators and preamplifiers, followed by an Analog to Digital Convertor process. Digitized values representing amplitude data as sequential, momentary values of a signal are then stored in RAM. Memory contents are then displayed using a Digital to Analog Convertor, and displayed on a scope-type CRT, or using a flat Electro Luminescent display.



What Are the Advantages of Using a Digital Storage Scope Over Using an Analog Storage Scope?

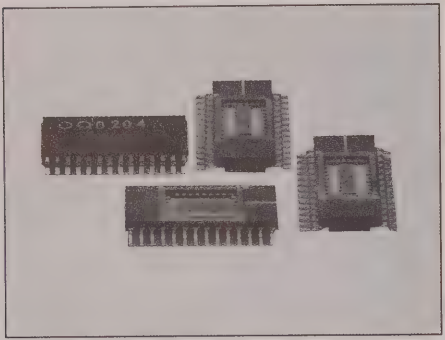
- With a Digital Storage Scope there is no risk of burning a storage layer inside the CRT since there is none.
- All displays of single events and repetitive signals are at the same brightness, regardless of sweep speed, and signal duty-cycle. Consequently, there is no need for continuous readjustment of focus, or astigmatism controls.
- Cursors can be moved freely over any waveform on the display, whether stored in memory as a single event, or as a repetitive signal.
- With a Digital Storage Scope, display parameters can be changed after a signal has been captured.
- Signals can be made available for data-processing, or the production of hard copies, using recorders, or plotters.
- Timing measurements are clock-based, and are more accurate.
- Amplitude measurements can be more accurate as well, because of the limited influence of linear circuitry.
- Storage times are virtually unlimited. With non-volatile memories, multiple waveforms can be stored for a period of many months after switching-off the instrument.
- Because of the long storage time capabilities, Digital Storage Oscilloscopes can wait for an unlimited time period for a signal to occur, without the screen "washing out". This translates to unlimited "babysitting".

What Performance criteria are important to the user?

- Sampling speed, determining the time resolution with which single events can be recorded and stored. Sampling speed is expressed in Megasamples/sec. (To avoid confusion with the instrument's bandwidth, it's best not to refer to MHz when talking about the sampling speed.)
- Bandwidth, and maximum stored frequency (MHz)
- Vertical resolution, expressed in bits, affecting an important aspect of achievable accuracy.
- Number of datapoints per record, per channel.
- Number of memories, available for signal comparisons and reference.
- Measuring capabilities.
- I/O capabilities.

Most Philips digital storage oscilloscopes employ a fast analog shift register (Charge Coupled Device or CCD) for fast and accurate signal capture. Once a signal is captured, the contents of the CCD are digitized and stored in memory. This mechanism ensures high effective vertical resolution at high clock speeds, even when capturing fast slew rate signals. Philips was the first to introduce the CCD technology to digitizing oscilloscopes. Based on the CCD conception in Philips' Physics labs in Waalre, the Netherlands (first published in 1966) and on Philips' extensive and world leading linear IC technology, a CCD, (also nicknamed "bucket-brigade"), and in particular the Profiled Peristaltic Charge Coupled Device (P^2CCD) proves to be a powerful, fast and efficient technique in the process of waveform digitizing. Rather than attempting to digitize high frequency waveforms or signals with fast transients with parallel digital conversion techniques, the P^2CCD provides a fast sampling, analog shift register to sample signal waveforms with excellent time resolution. The Philips chips used in Philips DSO's always incorporate two fast track-and-hold circuits, along with sample-and-holds and the CCD's themselves, as well as the output circuitry. They offer real time resolutions of up to 4 ns between data points, simultaneously on both channels, for the capture of single events.

Sampling is continuous and the samples are stored in analog format until the moment of triggering, at which point the input signal to the chip is slowed down and the samples are read out at the output of the chip in order to be digitized. An accurate sequential approximation A/D is used for this purpose. The overall result of such an arrangement is obtaining a high sampling speed while maintaining excellent vertical resolution, (even when digitizing fast slew rates), at low cost. For example, nowhere, at this moment, can you find a Digital Storage Oscilloscope that offers 100 Megasamples/sec on both channels simultaneously, at 8 bits, for a lower price than that of the Philips PM 3350!



Philips' proprietary P²CCD's that allow high speed signal capture.

What Are the Criteria in Selecting a Digital Storage Oscilloscope?

Y-Resolution

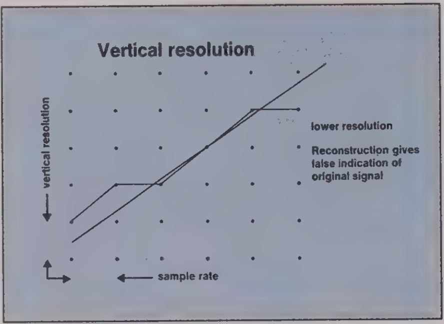
Since the description of a waveform and hence waveform fidelity is determined by the number of voltage levels available for storage, the specification of vertical bit-resolution is one of the key parameters and considerations in selecting and using a Digital Storage Oscilloscope.

Amplitude inaccuracy in a digitizing oscilloscope is the sum of the inaccuracies caused by linear circuits, plus the inaccuracy caused by the digitizing process.

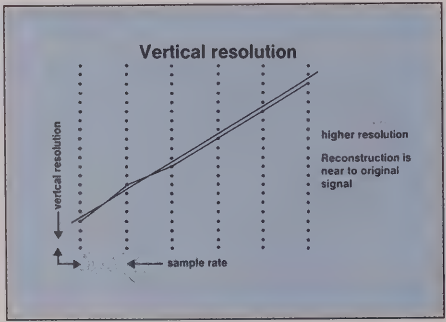
For example, for the Philips PM 3320A Digital Storage Oscilloscope, linear inaccuracy is specified as 1% of reading. With its 10 bit vertical resolution, the PM 3320A's A/D inaccuracy is 0.1% of full scale. Consequently, for a full scale signal, the overall amplitude inaccuracy will be 1 + 0.1 = 1.1%.

When details of signals are to be measured, which is often necessary, overall accuracy goes down. Examples are given to calculate the effects of full-scale digitizing, as well as digitizing accuracy of an amplitude of 10% of full scale for different types of conversions:

For a 10 bit conversion, as in the PM 3320A, accuracies are as follows:
At full scale: Lin error + A/D error = Result
1% + 100/1000 = 1.1%
For a 10 bit convertor, at 10% of full scale amplitude: 1% + (100/1000) x 10 = 2%
For an 8 bit conversion, as in most Philips DSO's and competitive models, accuracies are worse:
At full scale: Lin error + A/D error = Result
1% + 100/256 = l.39%
For an 8 bit convertor, at 10% of full scale amplitude: 1% + (100/256) x 10 = 4.9%
For a 6 bit conversion, as in some models available from other manufacturers, things get quite dramatic and much worse:
At full scale: Lin error + A/D error = Result
1% + 100/64 = 2.6%
For a 6 bit convertor, at 10% of full scale amplitude : 1% + (100/64) x 10 = 17% !!!



Significant signal distortion can result from signal digitizing with insufficient vertical resolution.



Signal distortion is greatly reduced by increased vertical resolution.

Offset Considerations

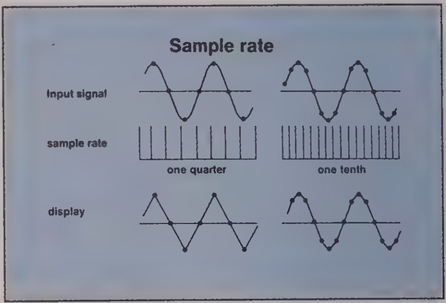
Inherent accuracy as offered by high-resolution Digital Storage Oscilloscopes such as the Philips PM 3320A, can be enhanced by input offset circuitry.

By using the built-in offset of up to 1000x the attenuator range used, no valuable vertical resolution is wasted on the conversion of DC. This way, all 10 bits of vertical resolution in the PM 3320A are utilized for digitizing the AC components of a signal with great accuracy. AUTO-OFFSET helps the user quickly find and use the appropriate offset voltage, which is then displayed in the CRT.

X-Resolution

The ability to resolve the signal's waveform in time, is determined by the speed of the A/D process. For single events, a good rule of thumb is that the A/D sampling speed be at least 10 x the highest frequency component of the signal to be captured, to obtain 10 datapoints per period. In other words, the highest frequency to be captured in a single shot mode is given by: Max sampling speed/10, for single shots.

It must be kept in mind that with a Digital Storage Oscilloscope, accuracies are related to the utilization rate with respect to Full-Scale settings. The accuracy with which timing elements of a signal can be determined, is directly related to the time resolution of the A/D process used, and the utilization of available datapoints by the operator. The higher the sampling rate, in other words, the higher the timebase speed used, the better the time resolution obtained.



Comparison of signal reproduction accuracy resulting from different sample rates. In the right-hand illustration, a sample rate of 1/10 of the signal frequency is used.

Different Sampling Techniques

Many Digital Storage Oscilloscopes have a vertical bandwidth which is far greater than can be utilized by the sampling speed of the A/D in a single shot mode alone. To allow full utilization of the scope's bandwidth, such scopes often offer a function which is called "Time-equivalent sampling". One system of "Time equivalent sampling" is called "Sequential Sampling". This function operates by taking one sample out of every successive period of a repetitive waveform, and reconstructing the wave shape out of these samples.

Another system operates on the "Random Sampling" principle, in which samples of the input signal are taken at random, with a precise time position measured and stored in memory, along with the waveform data for each point. The waveform is then reconstructed and displayed, with proper locations given to each point, depending on the time location measured at the moment of sampling. The benefit of the "Random Sampling" principle to the user is the ability to display pre-trigger signal information.

With either time-equivalent sampling method it is possible to store and display all frequencies that the front-end is capable of. Equally important, it allows the use of very high equivalent timebase sweep speeds, even with signals having very low repetition rates. Because waveforms are displayed from memory, the same uniformly high display clarity characteristic of any Digital Storage Oscilloscope are maintained.

Digitizing Ultra-High Frequencies

Many high frequency and high speed applications do require very wide bandwidths. Often, such application can benefit from all advantages that Digitizing Oscilloscopes have to offer: Automatic measurements of signal parameters, manipulation and calculation of wave forms, mass storage, and automatic go- no-go decisions.

One such instrument, the PM 3340, with a bandwidth of 2 GHz, is described in this catalog. Utilizing a sequential time-equivalent sampling technique, the PM 3340 offers a very high sensitivity of 1 mV/div at the rated 2 GHz bandwidth, and triggers to the full bandwidth as well. The PM 3340 offers full Digitizing Oscilloscope capabilities, including enveloping, save/stop on difference, histogram and FFT calculations, and EYE pattern and constellation diagrams for digital communication link testing.

Memories

Digital Storage Oscilloscopes can have multiple memories to allow reference waveforms to be stored. However, a primary selection criterion may be the length of each record that can be stored, especially in single shot applications. A long record with many datapoints allows the study of signal details after the single event has occured and been recorded.

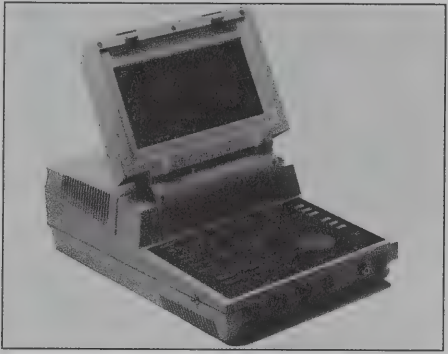
The PM 3308 and PM 3335 offer very long record lengths of up to 8k to facilitate this. In addition, the PM 3308 can store up to 100 waveforms in non-volatile memory, for waveform calculations and comparisons, and also eliminating the need for vulnerable mechanical mass-storage devices such as floppy or hard disk drives to be taken to the field.

There is usually a trade-off between the number of datapoints available in each record, and the speed and resolution of the A/D process. In some instruments, record lengths are a function of sweep speed used, and also dependent on the selection of resolution made by the user, when looking at repetitive waveforms. Digital delay techniques help to avoid filling memory locations with useless information and optimally combining A/D speed and resolution.

Displaying the Signals

In most Digital Storage Oscilloscopes, a CRT is used to display waveforms and operational settings.In order to provide sufficient measuring area along with clear and uncluttered operating information, the Philips PM 3320A and PM 3340 oscilloscopes offer extra large screens, leaving the measuring area unobstructed.

Unique in the field of powerful Digital Storage Oscilloscopes is the Philips PM 3308, offering a large flat screen. An electro luminescent display is used to provide excellent readability under all lighting circumstances. The display provides information on instrument setup, measurements and wave forms. As this active display is of the dot matrix type, focus controls are not needed and astigmatism is non-existent. It's small size enables it to be folded down like a clam-shell for protection and provides the PM 3308 with compactness and portability.



Cursor Measurements - Digital Storage Oscilloscopes

In a Digital Storage Oscilloscope, cursors are not merely electronic graticule lines displayed over the oscillogram on the screen, as is the case in an analog scope. Instead, in a Digital Storage Oscilloscope, cursors represent display highlights of actual datapoints present in memory. The numerical value of the delta-distance between cursors is therefore extremely accurate. Measurement accuracy of signal parameters is a function of the utilization of available memory width (vertical bits used) and timebase speed.

Since Digital Storage Oscilloscopes usually have an abundance of microprocessor power on board, many automatic calculations may be easily available, providing direct readouts of risetimes, mean values, RMS, frequencies, PP values etc. In the PM 3320A and PM 3340, for example, waveform calculations can be performed and parameters can be measured. Based on their 32 bit data structure and microprocessors, supported by Discrete Processing Units, these calculations and measurements can be executed and updated at high speed, even as the instrument is collecting new data. It is even possible to test newly collected waveform data against references and have the scope automatically take action when a newly acquired waveform violates predetermined waveform criteria.

I/O Considerations

Some analog oscilloscopes can be controlled by an external controller and sometimes interrogated so that knob settings can be stored, or values between cursors can be found. Good examples of such instruments are the Philips 60 MHz and 100 MHz PM 3050, PM 3065 and PM 3070 series, as well as the 200 MHz and 400 MHz PM 3285A/86A and PM 3295A/96A series.

DIGITAL STORAGE OSCILLOSCOPES allow for control and interrogation, but more importantly, they allow for transfer of waveform data from scope to controller and back. With this capability, all computing power of a controller becomes available for waveform processing, mass storage, comparison of waveforms and documentation.

Software and Hardware Support for GPIB/IEEE-488* Applications

Digital Storage Oscilloscopes (DSO's) are often used in automatic test and measurement systems. Waveforms measured with a DSO are stored in its memory and can be processed/displayed on request, or transferred to a computer for more extensive processing, display, mass storage or documentation.

All of the Philips Digital Storage Oscilloscopes are programmable, and addressable through the GPIB/IEEE-488 bus, and a number of them through the serial RS 232 port as well.

Fluke and Philips offer a number of software package to ease programming of GPIB systems applications. These PM 2230 Series Instrument Drivers and PM 2240 TestTeam allow GPIB instruments to be easily programmed and result in easy to understand and reliable test programs. The PM 2260 Oscilloscope Signal Processing software is a package for the PC and compatibles that extends the DSO's capabilities with an extensive set of interactive waveform processing and display facilities. For further information on these packages see page 58.

Extended "Probe-ability" is important in most applications in automatic test and measurement systems, where waveforms have to be sampled at several different points on the device under test. The PM 2295/09 Probe Switch Unit with a full 400 MHz bandwidth can be used for this purpose: under GPIB control it can switch 1 out of 4 signals to the input of the oscilloscope, still maintaining the high input impedance and low load at the tip of each of the four probes. For further information on this product see page 58.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3340

GPIB
IEEE-488

NEW

PM 3340

PM 3340 2 GHz Digitizing Oscilloscope

- DC to 2 GHz bandwidth
- 175 ps risetime
- Trigger response up to 2 GHz
- 4 memories of 4 kbytes x 10-bit words
- 1 mV/div vertical sensitivity
- Automatic measurements of amplitude, time, frequency and phase
- Signal processing including basic algebraic functions, plus filter, FFT and histogram
- Eye pattern mode for PCM inspection
- Standard GPIB/IEEE-488 and RS 232C interfaces
- Probes operate over full bandwidth
- Autoset function gives instant front panel set-up for any input signal

Introduction

The digitizing oscilloscope PM 3340 provides measurement, storage and analysis of input signals from DC to 2 GHz. The applied sequential sampling system not only provides you with a large display bandwidth, but also offers an unmatched 2 GHz triggering. Signal analysis is facilitated by a fast timebase including post- and pre-trigger modes, and a vertical dynamic range which permits the max. allowable input signal to be observed at an amplitude scale of 1 mV/div.

Measurement cursors provide a variety of automatic measurements, so that input signal parameters can be verified quickly and reliably. Signal processing modes such as FFT, digital filtering and save on difference are included as standard. A special eye pattern mode allows the display of random pulse patterns, such as in PCM or QAM, as well as the display of constellation diagrams.

The instrument is fully GPIB/IEEE-488* and RS-232C compatible. This includes computer controlled operation, data transfer between instrument and controller plus hard copies on standard plotters and printers.

In addition to its many powerful features, the PM 3340 is very easy to operate thanks to the Autoset facility, quickly updating its menu-driven analyzing functions and a setting memory for more than 250 preprogrammed front panel settings.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Reliable Measurements of High Speed Signals

Advanced technologies like ECL or GaAs need oscilloscopes that can display risetimes and propagation delays in the sub-nanosecond domain. PM 3340's risetime of 175 ps and 2 GHz bandwidth make the PM 3340 ideal for these applications. Moreover the pulse response, thanks to its 50Ω input and a sampling system actually at the input, is more reliable than in any analog or digital oscilloscope with conventional input attenuators and amplifiers. Inputs are via high-speed N-connectors combining ruggedness and a superior VSWR.

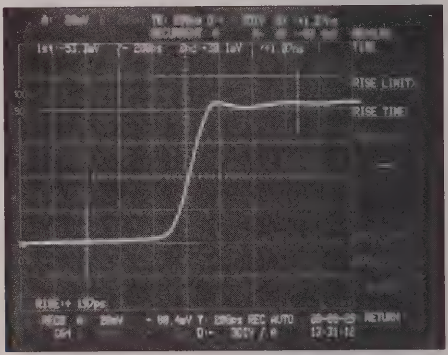


Fig. 1: Reliable pulse measurements are obtained from a carefully designed 50Ω input system.

Wide Dynamic Range

A floating input sampling bridge enables an input signal range of 1 mV/div up to 200 mV/div. This allows for any signal up to 1.6V to be expanded up to 1 mV/div with no distortion. Offset controls allow you to position any signal detail in the viewing window of 8 by 10 cm. Signal probes increase the range of 200 mV/div up to 2V/div or 20V/div if larger amplitudes have to be measured.

Noise Suppression

A high sensitivity input, together with the large bandwidth, can generate a noisy display. If so the averaging mode will reduce this noise drastically, enabling a clean display to be achieved even at the highest sensitivities.

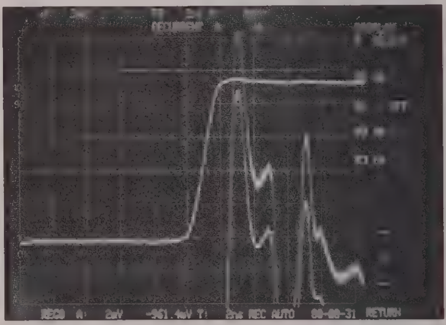


Fig. 2: A fast pulse is 100 x expanded and the resulting noise is subsequently suppressed by averaging the input signal..

Triggering up to Full Bandwidth

Many HF applications, for example in radar, satellite links or fiber optics, need GHz triggering. A new approach in the PM 3340 — a fast prescaler — extends trigger capabilities up to 2 GHz. Optimized trigger modes for low amplitudes (SYNC mode) and for high frequencies (COUNTDOWN mode) can be chosed by the operator, or selected automatically by the AUTOSELECT function. In both cases front panel LEDs show which mode is operating.

Waveform details both before and after the trigger point can be displayed. The selected negative (pre-trigger) or positive (post-trigger) delay is adjustable over a wide range dependent on the selected time scale. For example a signal in a 100 ps/div timebase can be shifted over 90 divisions pre-trigger and 70 divisions post-trigger.

Clear Unambiguous Display

The PM 3340 has a 10 x 12 cm CRT. The center area of 8 x 10 cm is used for waveforms; setting parameters and measuring results are displayed in the remaining screen part. Four signal memories enable comparison of waveforms or display of processing results. The contents of the non-volatile memory can be displayed simultaneously or individually and memory back-up ensures you always have a back-up of data.

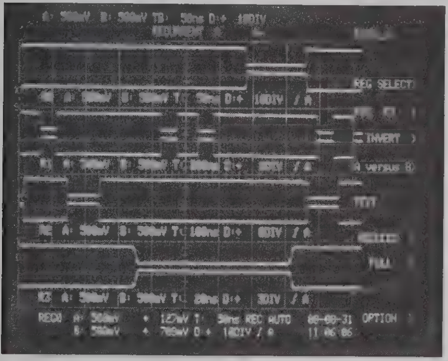


Fig. 3: Up to 8 waveforms can be displayed simultaneously (2 channels by 4 registers).

Waveform Measurements and Signal Processing

The PM 3340 offers a host of waveform measurements for both engineering and production environments. Once set, the instrument automatically measures time intervals, rise times, frequencies, amplitudes etc. without the need for resetting the scope for a new waveform. Time intervals between any waveforms in any register may be measured, allowing for example, automatic tests on semiconductor switching times.

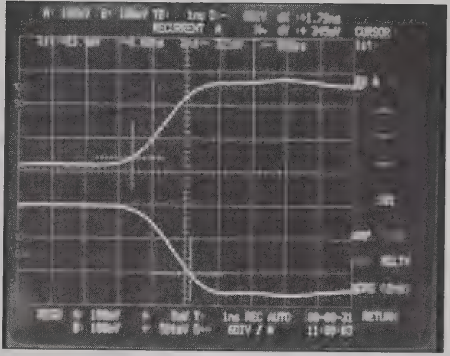


Fig. 4: Time interval measurements as required for semiconductor switching time.

Input signals can be checked for max. and min. deviations, for example for noise or jitter measurements, or signals passing a predetermined threshold can be saved automatically. An FFT function allows frequency rather than time domain display.

In many telecommunication systems using digital radio links or cable transmissions, datastreams are measured in the form of eye patterns. The PM 3340 offers a dedicated eye pattern mode in which signals are displayed with a unmatched sample density of 4000, or even 12000 in the multiple eye mode. This approach ensures that no information is lost, even in case of very noisy signals.

In case of Quadrature Amplitude Modulations (QAM) two signals, the In-phase (I) and Quadrature (Q), can be combined into a constellation diagram via the A versus B mode.

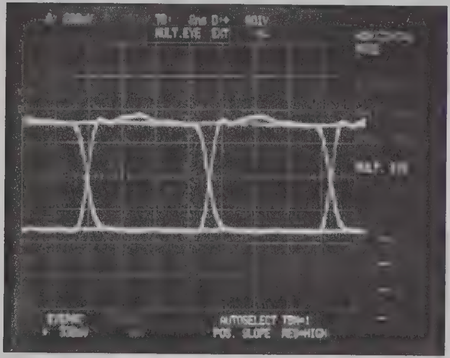


Fig. 5: Eye pattern formed by PCM signal.

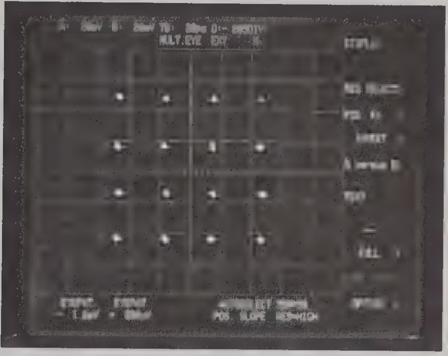


Fig. 6: 6 QAM signals presented on a constellation diagram.

Interfacing and Hardcopy

IEEE-488 and RS 232C interfaces are built-in as standard, allowing all controls to be set or interrogated and data transferred to and from any of the four memories. Digital printers/plotters can be used to obtain hard copies of waveforms with relevant alphanumeric data. An analog output for X-Y recorder is also available.

User Friendly Operation

Operation of the PM 3340 has been optimized for user-friendliness. All main functions are directly accessible and self-explanatory softkeyed menus provide the various signal processing functions. The CRT presents all waveform information on new input signals as well as the contents of any memory.

Initial set-up is by a single Autoset button, automatically providing an immediate on-screen display of both input signals. Repetitive measurement set-ups can be programmed and recalled via the setting memory keyboard, without the need for a computer. Two 32-bit microprocessors plus a Discrete Processing Unit assume quick updates of displays and measurements, further enhancing the operator interface.

Signal Probing

Many engineering applications ask for reliable signal pick-ups, with minimum loading of the signal source. Two 1 pF//500Ω passive probes with full 2 GHz bandwidth are included in the package. If higher DC impedance is required, 5 kΩ//1pF passive probes and a 1:1 FET probe (1 MΩ//1.5 pF) are also available.

Digitizing Scopes and High Speed Measurements

Any digitizing or digital storage oscilloscope uses the principle of sampling at regular time intervals. Sampled values are digitized and stored in a memory; then the original waveform is reconstructed by scanning the memory and displaying its content on a CRT.

PM 3340

Non-recurring input signals require the maximum possible number of samples to be taken while the signal is present: this is called real-time sampling. The sample rate determines the maximum signal speed of single events which can be captured by the oscilloscope.

Repetitive signals can be handled differently. Collecting the required samples can be spread over several periods of the input signal. This principle is called **repetitive sampling.** There are two ways in which repetitive sampling is performed:

- Random sampling, where the moment at which sampling occurs is determined by an internal clock and is not related to the input signal.
- Sequential sampling, in which the input (trigger) signal determines the moment at which sampling occurs.

The PM 3340 employs sequential sampling; samples are taken at increasing time intervals after the trigger moment. At least 512 signal periods are necessary to collect all samples for a complete reconstruction of the input signal.

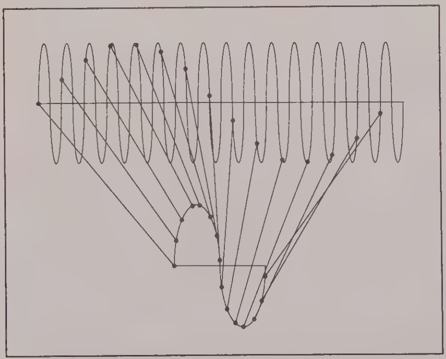


Fig. 7: Several periods of the input signal are sampled for reconstruction of the waveform.

Wide Dynamic Input Range

The input circuit has a high speed sampling gate which converts the input signals into an LF signal. The sampling gate is rebiased by a feedback circuit after each sampling action to the level of the last signal sample, so only differences between successive samples are measured, resulting in an excellent linearity over a wide dynamic range.

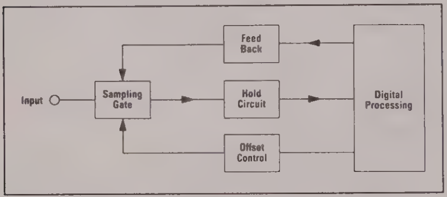


Fig. 8: Input circuit of sequential sampling scope.

The offset control allows the operator to scan the input signal to select any detail for precise observation.

High Bandwidth

The bandwidth of a sequential sampling system is determined by the sampling gate. A sample pulsewidth of less than 175 ps results in a bandwidth of at least 2 GHz. Trigger pick-off and delay line are part of the 50Ω impedance circuit, which contributes to the excellent pulse response of the instrument.

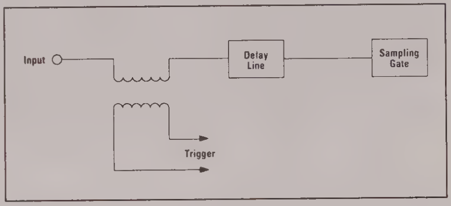


Fig. 9: VHF part of input.

Image Construction Speed

Different sampling systems give different speeds of display build up. Rather than random sampling, sequential mode only samples that part of the signal which will be displayed on screen. Moreover, as sequential sampling is related to the input signal, sample density is equal for all signal parts and no parts are missing.

Although for relatively low frequencies sequential sampling requires more time, at higher speeds this approach builds up the display much faster than other sampling systems, especially if parts of a waveform, such as risetime are measured

Specifications

Technical Specifications

Signal Acquisition

Autoset: Sets display, text, vertical settings, horizontal settings and triggering for instant overall-view display of input signal
Sampling: Sequential
Sources: Ya, Yb
Modes: Single-channel, dual-channel, added
Polarity: Each channel can be inverted
Processing: Normal, eye pattern (single- or dual-channel modes only), average, multiple sampling, absolute min/max

Range:
Vertical: 10 div
Horizontal: 10.2 x time/div

Resolution:
Vertical: 1:1024 (10-bit)
Horizontal: 1:512, 1:256, 1:128, 1:64 (in fast display mode 1:64)
Minimum Acquisition Time: <25 ms for max. horizontal resolution

Y Channels

Input Impedance: 50Ω ±1%
VSWR: 1:1.3 up to 1 GHz; 1:1.4 up to 2 GHz
Input Coupling: DC
Max. Input Voltage: 5 V$_{peak}$, pos and neg
Deflection Coefficient: 1 mV/div...200 mV/div. (in 1, 2, 5 sequence)
Error Limit: 1.5%
Deflection Coefficient in Eye Pattern Mode: 5 mV/div...200 mV/div
Error Limit: 10%

Continuous Control Between Steps:
  Range: 3:1
  Resolution: 1:4096 (12-bit)
Error Limit: 3%
Frequency Response: DC...2 GHz (-3 dB)
Risetime: 175 ps (calculated value using t_r = 0.35/bandwidth
Visible Signal Delay: 9 ns
Dynamic Range: -0.8V...+0.8V

DC Offset:
Range: -1.6V...+1.6V
Resolution: 0.01 div
Common Mode Rejection: 40:1 up to 100 MHz
Channel Isolation: 1000:1
Noise: <0.5 mV (RMS)
Averaging: x2...x64 in powers of 2
Multiple Sampling: x2...x32 in powers of 2

Timebase

Acquisition Mode: Recurrent, single scan, multiple scan, multiple eye, save/stop on difference

Deflection Coefficient:
Timebase: 1 ns/div...20 µs/div (error limit 3%)
Magnifier: x2 ... x50 (error limit - add 2%)
Fastest Sweep: 20 ps/div
Delay: Controllable in steps of div or screens
Maximum Negative Delay: 9 ns
Maximum Positive Delay: 10 div at timebase setting of 20 µs/div and magnifier x1
Hold-off Time: 30 µs...75 µs at max. horizontal resolution

Triggering

Sources: Ya, Yb, EXTernal
Input Impedance: 50Ω ±1%
Coupling: AC (RC time: 1 µs)
Max. Input Voltage: ±5 V$_{peak}$, pos and neg
Modes: Trigger, synchronize, countdown and AUTO select

Sensitivity:
Trigger Mode: 10 mV (up to 100 MHz)
Sync. Mode: 2 mV (up to 100 MHz)
Countdown Mode: 50 mV (up to 2 GHz)

Level Range:
High Sensitivity: +4 mV...-4 mV
Low Sensitivity: +40 mV...-40 mV
Level Resolution: 1:16384 (14-bit)
Slope Selection: + and -
Jitter: 7 ps (RMS, timebase at 1 ns/div.)

Memory

Memory: 4 memories of 4 k x 10-bit words
Functions: Clear, save, write, lock

Display

Modes: Dot join, dots only, invert, A versus B
Registers: Register R0, R1, R2 and R3 can be displayed in any combination

Expansion:
Horizontal: 1...64 in powers of 2 (Y vs t), 1...8 in powers of 2 (A vs. B), continuous control between steps
Vertical: x0.2, x1, x5
Position: All registers can be positioned independently
Horizontal: +5 div...-5 div (expansion x1)
Vertical: +5 div...-5 div (expansion x1)

Cursors

Vertical Resolution: 1:1024 (10-bit)
Vertical Error Limit: 1.5%
Horizontal Resolution: 1:4096 (12-bit)
Horizontal Error Limit: 3%

Setting Memory

Memory Size: 251 front panel settings
Functions: SAVE, INSERT, DELETE for storage or erasure of settings: RECALL, NEXT, PREVIOUS for recall of settings

Calibration Output

Squarewave Voltage:
Amplitude: 1V ±1% into 50Ω
Frequency: 100 kHz ±0.1%
Impedance: 50Ω ±1%
Risetime: 1.5 ns

Plot Output

Analog Outputs: Screen dump or register dump
Output Voltage Vertical: 1V
Output Voltage Horizontal: 1V
Error Limit: 3%
Pen Lift: TTL-compatible
Plot Time: Adjustable between 20 ms and 2s per dot
Digital Plot Output: HPGL and Philips language compatible: up to 4 screens on standard A4 size
Printer Plot Output: Compatible with Epson (FX80) and HP Thinkjet

CRT

Type: Philips 18cm rectangular PDA tube
Useful Screen Area: 10 cm x 12 cm
Graticule: Internal, with variable illumination
Acceleration Voltage: 16 kV

Power Supply:
Voltage: 90V...264 VAC
Frequency: 45 Hz...440 Hz
Power Consumption: 136W
Memory Back-Up: 2 LR6 batteries (Size AA)
Retention Time: 2 years

Interface

Interface board: contains IEEE-488 interface, RS 232C interface and real-time clock
IEEE-488 (IEC-625) Interface
Bus Driver: E2 (three-state)
Interface Functions:

Source Handshake	SH1	Fully capable
Acceptor Handshake	AH1	Fully capable
Talker	T5	Basic talker, serial poll, talk only and unaddress if MLA
Listener	L3	Basic listener, listen only and unaddress if MTA
Service Request	SR1	Fully capable
Remote/Local	RL1	Local lock-out
Parallel Poll	PPO	No parallel poll
Device Clear	DC1	Fully capable
Device Trigger	DT1	Fully capable
Controller	CO	No controller
Address	0...30	
Default Address	8	

RS 232C Interface:
Connector: RFI/EMI

Bus Drivers:
Data Circuits:
Spacing "0" >+3V (TxD)
Marking "1" <-3V (RxD lines)
Control Circuits:
ON >+3V (RTS, CTS, DSR)
OFF <-3V (DTR lines)
Current Output: <10 mA
Input Impedance: 300Ω
Output Impedance: 3 kΩ...7 kΩ
Input Voltage: -7V...+7V
Output Voltage: -25V...+25V

Interface Functions:
Baud Rate: 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600 or 19200 (input and output separately selectable)
Stop Bits: 1 or 2
Parity: Odd, even or none
Length: 7 or 8
Transmission: Asynchronous, full duplex

Handshake:
Software XON/XOFF
Hardware DSR/DTR and CTS/DTR

Serial Poll	ESC 7
GoTo Remote	ESC 2
GoTo Local	ESC 1
Device Clear	ESC 4
Device Trigger	ESC 8
Local Lock Out	ESC 5

Measurement and Mathematical Functions

Voltage Measurements: RMS (including or excluding offset voltage); Mean (including or excluding offset voltage); Peak-to-peak; Peak-to zero; Negative peak-to-zero; Overshoot and Preshoot

Time Measurements: Risetime (Falltime) over 10%...90% or 20%...80% of waveform, or within variable boundaries; Pulse width; Duty cycle (expressed as a percentage of period); Frequency; Phase

Mathematics

Result of calculation displayed in selected register and scalable for optimum display
Basic Arithmetic Operations: Add, Subtract, Multiply, Divide, Differentiate, Integrate
Amplitude Histogram: Amplitude density vs. absolute amplitude of an input signal
FFT: Frequency domain presentation of input signal
Window: Rectangular, Hamming, Hanning
Vertical Scale: lin. or log
Dynamic Range: 49.8 dB
Horizontal Scale: lin.
Filter: Digital filter of order 3, 5, 9, 17, 33, 65, 129
Delay Channel: Allows compensation of delay between channels or signal probes

Vertical Processing Modes

Eye Pattern: Displays pseudo-random pulse pattern, showing eye height and width
Absolute Min/Max: Measures and stores max/min changes in amplitudes of an input signals in a selected register (envelope mode)

Horizontal Processing Modes

Multiple Eye: Displays eye pattern in 12k memory size for optimum signal representation
Save/Stop on Difference: Input signals outside the limits of a reference signal are saved in a selectable register or stop the acquisition.

General Specifications

Mechanical Data

Height: 176 mm (6.9 in.): 250 mm (9.8 in.) with feet and pouch, 5E in 19-in. rackmount version
Width: 419 mm (16.5 in.): 465 mm (18.3 in.) with handle
Depth: 570 mm (22.5 in.): 670 mm (26.4 in.) with handle
Weight: 18.7 kg (41.2 lb.) excl. accessories

Environmental Characteristics

Meets environmental requirements of MIL-T-28800C Type III, Class 5, Style D

Temperature:
Rated Range of Use: +15°C...+35°C
Limits of Operation: 0°C...+50°C
Storage: -40°C...+70°C

Altitude:
Operating: 4500 m (15000 ft)
Storage and Transport: 12000 m (40000 ft)
Maximum Humidity: 95% RH
Vibration: Frequency 5 Hz...55 Hz
Maximum Acceleration: 30 m/s^2
Shock: 6 shocks on each axis, half-sinewave, plus duration 11 ms, peak acceleration 300 m/s^2

PM 3340

Bench Handling: MIL-STD-810 method 516, procedure V
EMI: MIL-STD 461 Class B, VDE 0871 and VDE 0875
Safety: Meets the requirements of IEC 348 Class 1, VDE 0411 Class 1 UL 1244, CSA 556 B

Included with the Instrument: 2 passive 10:1 probes PM 8911/08 with scale read-out (input impedance 500Ω//1 pF, cable length 1.5m), blue contrast filter, 2 BNC-N adapters, probe-BNC adapter, operating manual, programming manual, quick operating guide, cable for analog plot output

Ordering Information

Models

January 1989 prices

PM 3340/403 1 GHz Digitizing Oscilloscope including FFT and IEEE-488/RS-232 Interfaces	$16,000
PM 3340/803 same with 19-inch Rackmount	16,275

Accessories (Also see page 53)

PM 8911/08 Passive 10:1 Probe	275
PM 8912/08 Passive 100:1 Probe	275
PM 8943Q FET Probe	850
PM 8964/40 19 inch Rackmount Kit	650
PM 8991/04 Oscilloscope Cart	$450
PM 8992/80 Accessory Pouch	45
PM 2122/01 50Ω Coaxial Switch	680
PM 2195/09 Probe Switch 400 MHz	650
PM 2230/001 Instrument Drivers Software Service	590
PM 2240/001 TestTeam Software	925
PM 2260/001 Oscilloscope Signal Processing Software	800

Service and Support

One-year product warranty. See page 470 for further information on warranty terms and conditions.

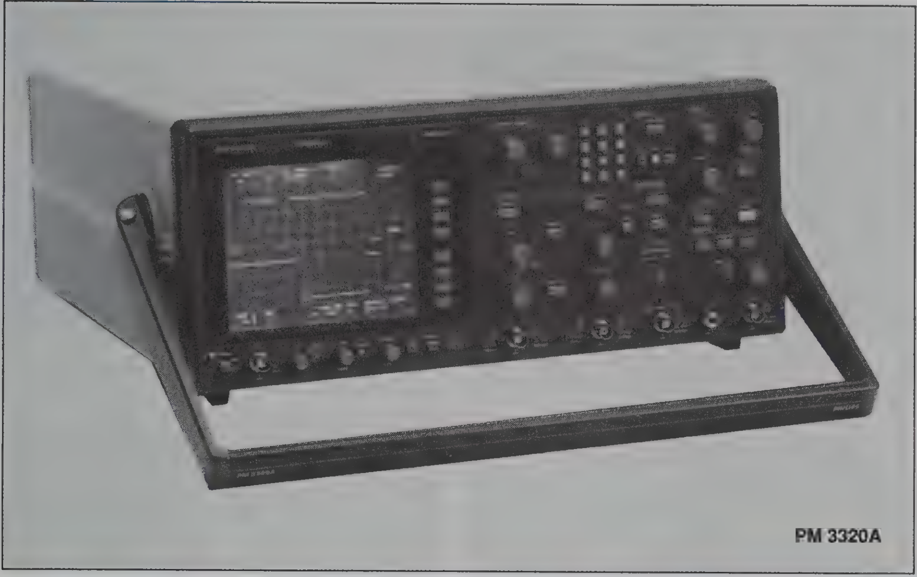
Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3320A

GPIB
IEEE-488

RS-232

NEW


PM 3320A

PM 3320A 250 Ms/s Digital Storage Oscilloscope
Bandwidth of 200 MHz
250 megasamples/sec sampling rate for each channel
4 ns horizontal resolution per channel, single shots
10 bit vertical resolution
Four 4K deep memories
Horizontal expansion of up to 128 times
Cursor measurements automatically include probe factors
Waveform processing capabilities

Extensive Acquisition and Display Functions

The PM 3320A has extensive acquisition, calculation and display functions to capture exactly the signals of interest and quickly extract the information and measurements required.

The PM 3320A offers an absolute min/max mode ('envelope' mode) that creates a cumulative record of signal amplitudes over the measuring period. Histograms that show the amplitude distribution of signals in the period can be displayed.

Also available are stop on difference and save on difference modes. These allow signals outside a predetermined range to be captured, after which acquisition stops ('stop on difference') or continues with successive overwriting of the acquisition information stored in the registers ('save on difference'). In both cases the signals are time and date stamped to help relate intermittent faults to possible external causes. In combination with the other acquisition modes such as pre- and post-triggering, offset and restart, the PM 3320A offers exceptional versatility in capturing and analyzing exactly the signal of interest. A complete measurement center in one unit.

Inputs and Signal Acquisition

The PM 3320A's power and versatility provide for a wide range of signal conditions. Two signal inputs are provided, each with a choice of 1 MΩ or 50Ω input impedance. The built-in 50Ω terminations are protected against damage through overloads by a combination of software and thermal protection.

Calibrated offset of up to 1000 x scalefactor permits the full utilization of the instrument's 10 bit vertical resolution.

Noisy signals can be acquired using a 'running-average' algorithm, taking into account up to 64 input signals. And signals with unknown DC components can be quickly displayed and stored using AUTO-OFFSET.

Further, the PM 3320A's fast 250 Ms/s digitizing rate applies to both channels, simultaneously, and synchronously. It offers a full 4 ns resolution for each channel, for repetitive signals and single events! And random sampling permits the use of higher time base speeds for repetitive signals, so that the full 200 MHz of the instrument can be used and stored.

Each channel is also provided with a dual, fast peak-detector which permits the capture of events down to 3 ns, even when slow time base speeds are used. This is not only useful to catch short glitch-type signals over longer time windows, it also allows the instrument to accurately digitize and display high frequency signals which are modulated in amplitude by a lower frequency, without aliasing.

For the slowest of signals, a roll mode is provided. The roll mode can be triggered, if desired, to stop at any significant signal detail.

Triggering and Delay Capabilities

The PM 3320A can be triggered from a choice of internal and external signal sources.

Pre-trigger of up to one full screen is possible, not only in the direct acquisition modes, but also at the higher time base speeds, thanks to the instrument's random sampling technique.

Extensive post-trigger recording with delays of up to 1000 screen lengths allows the analysis of small signal details out of long and complex signals. In addition, the RESTART function which operates as a 'Smart Autostart' make finding such details a snap and provide a better alternative to the traditional Delayed Sweep arrangement.

Trigger level can be checked in the CRT display for fast setup, for all selected trigger sources, whether internal, or external.

Trigger delay can also be used to give an internal time delay after an external event.

The PM 3320A also offers excellent TV trigger capabilities. (See also PM 8917.)

Storage

Signals from each channel can be stored in each of four 4K memories. This allows for easy comparison of waveforms, or the display of references. A unique, multiple-single-shot mode allows for quick and automatic storage of up to four dual-channel single shots.

All waveforms are kept with all relevant acquisition parameters, such as sensitivity, time base, and delay settings at the moment of recording. A real-time clock provides automatic 'time stamps'.

Full compatibility with GPIB/IEEE-488* and RS-232C allows for almost unlimited recording of waveform data on external devices.

Display and Soft Keys

The PM 3320A has a 10 x 12 cm CRT screen. The center 8 x 10 cm area is used for waveforms exclusively, with no disturbing alphanumerics.

The edges of the screen display waveform acquisition data, of live signals, or of previously recorded waveforms.

The right hand side of the screen is always used for soft-key displays. A separate numeric keypad allows direct input of pertinent data such as offset and delay.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3320A

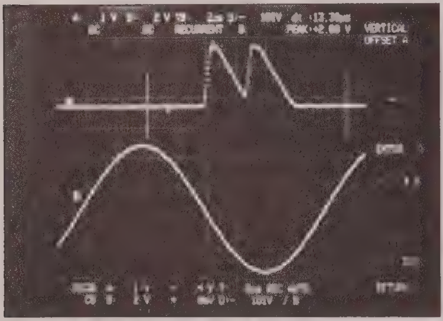
Operation and User Friendliness

All main functions of the PM 3320A are directly accessible to the user, without the need to learn soft-key menus. This also eliminates the time consuming need to back up through various levels of menus to change instrument settings.

And Philips' 'Green-button' Autoset provides for even faster set-ups by automatically defining acquisition parameters. This is a great help in finding and viewing previously unknown signals.

Once captured, waveforms are already displayed, with no interference from text or menus. All texts are displayed along the screen edges, with only channel identification (A or B) displayed with the relevant trace, for each memory.

The PM 3320A even shows a warning when aliasing due to undersampling is detected!

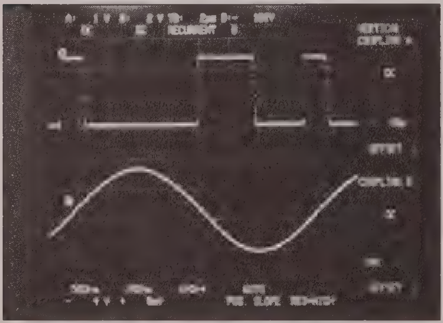


The PM 3320 screen is a complete information center. Because of the 10 x 12 cm screen size and a full 8 x 10 cm measuring area, no text is interfering with the displayed waveforms.

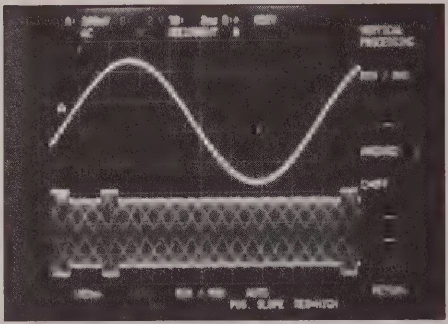
SetUp Memories

The PM 3320A's user-programmable setup feature allows even greater ease of use, providing automation without a computer. This also ensures repeatability of tests and results.

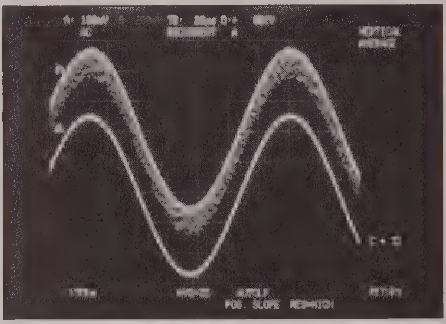
Up to fully 250 user-defined instrument setups can be stored for measurements of user-specific interest. These can be stored in combinations of sequences of steps, and can be recalled sequentially, or at random.



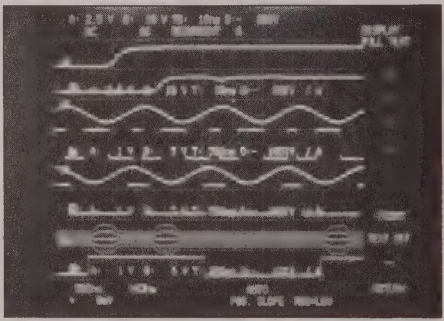
The PM 3320A has selectable 50 Ohm or 1 Megohm inputs. The 50 Ohm input termination is protected by software and thermal protection.



Vertical signal processing includes averaging, Bandwidth limit and Min./Max. incorporating a fast Track-and-Hold circuit in each channel to reveal spikes and glitches down to 3 ns, even at low time base speeds.



The PM 3320A's "running-average" not only reduces random noise, but it allows the user to maintain the instrument's full bandwidth and get the most out of the ultra-fine 10 bit resolution.



Signals from each channel can be stored in each of the four 4k deep memories. Memory contents are held in non-volatile memory, along with all relevant setting parameters, displayed here.

Versatile Measurement Functions

Once a signal has been acquired, the PM 3320A offers a full range of measurement and calculation functions to help you extract exactly the information you want from the signal. Measurements of voltage and time differences between the cursors positioned on a single waveform are possible. The PM 3320A also allows comparative measurements to be made between two waveforms recorded on channel A and channel B, or between separate waveforms stored in any of the instrument's four memory registers.

In addition to these absolute and relative time and voltage measurements, PM 3320A has the facility for phase measurements. In each case, all that's necessary is to position the cursors on the desired part of the signal or signals concerned, make a simple menu selection of the required measurement, and the result is indicated clearly and immediately by an on-screen alphanumeric read-out.

Cursors can also be used as 'Smart-Start cursors'. When the cursors are placed over any signal detail of interest, the activation of 'Restart', automatically reestablishes proper delay and sampling speed to acquire that detail with maximum resolution.

Advanced Signal Processing Modes

The PM 3320A offers more than signal measurements alone. A wide range of signal-processing modes allow you to explore more deeply into your acquired signals, and perform calculations that reveal hidden data and relationships.

The basic arithmetic functions of add, subtract, multiply and divide are supplemented by signal differentiation and integration, as well as amplitude histograms, the application of digital filters and an optional FFT facility for signal representation and analysis in the frequency domain.

Interfacing

The I/O option of the PM 3320A offers GPIB/IEEE-488* and RS 232C interfacing. All controls can be set; all controls can be interrogated. Waveform data can be taken from any of the four memories, or be fed to the scope.

All front panel menus can be defined by the controller, as well as called by the controller, to greatly simplify bus operations.

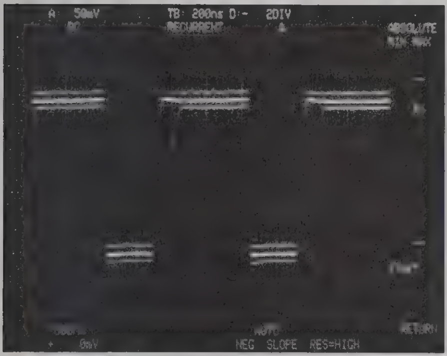
Hard Copies

Each PM 3320A is equipped with an analog output to drive an analog XY recorder. The operator can select any waveform in any memory to be drawn by the recorder.

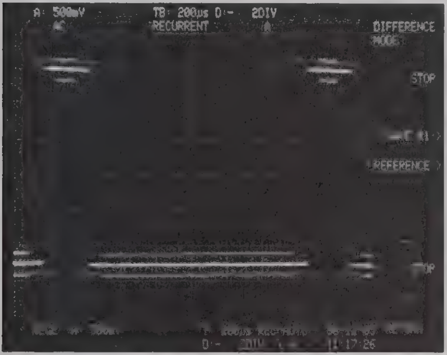
I/O option-equipped instruments further provide direct output to digital plotters. A digital plotout of any waveform is possible, along with alphanumeric data pertinent to that waveform.

Construction

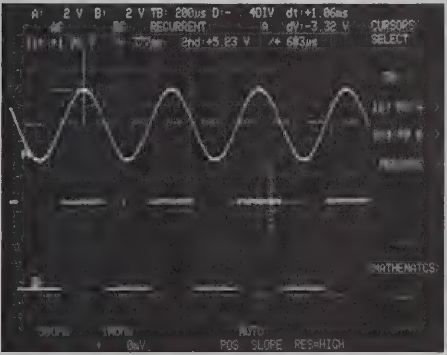
The PM 3320A's construction provides for a variety of operating configurations. At just under 18 kg, it can easily be carried from one location to another, and the carrying handle doubles as an adjustable stand. Scopecart PM 8991/04 offers further mobility. In addition, a rackmountable version of the PM 3320A for use in standard 19 inch racks is also available.



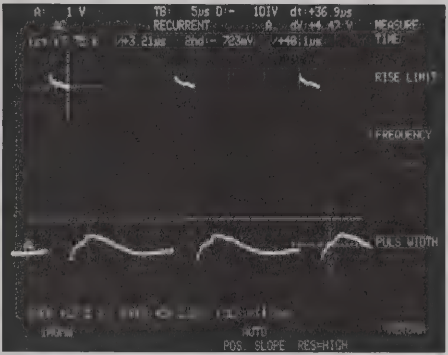
1. Absolute min/max mode creates the “envelope” of your signal variations for viewing drift and jitter.



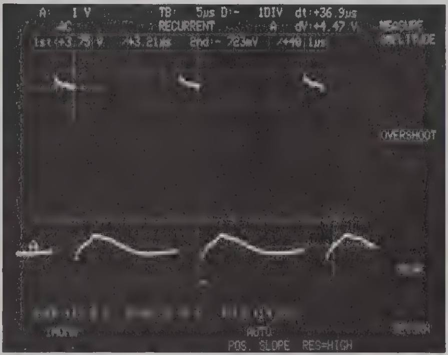
2. Use save/stop on difference together with the 3 ns glitch capture to detect and freeze intermittent faults (together with the time and date stamp).



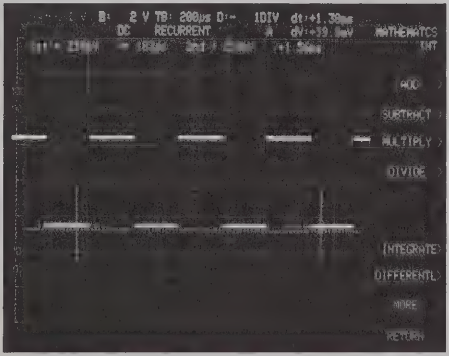
3. As should be expected of any high performance DSO, a wide range of measuring facilities are offered. Absolute ground referenced results are achieved on up to two traces selectable from any of the 8 displayable waveforms.



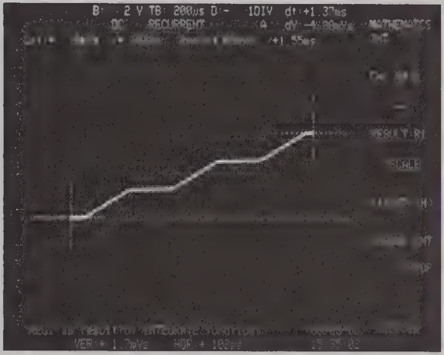
4. Together with the cursor measurements on a single trace, selection can be made from a wide variety of automatic and calculated results. Amplitude measurements of RMS, mean, peak-peak, pulse overshoot and preshoot can be readily selected.



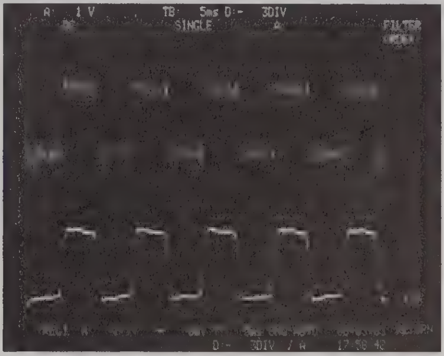
5. Further time measurements of frequency, period, pulse width, duty cycle and rise time are available to give timer/counter results. Even phase can be measured between channels and/or waveforms.



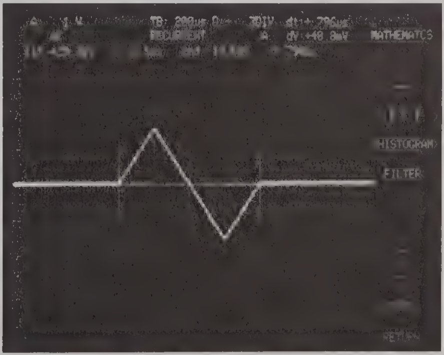
6. A full math facility gives processing power to display waveforms in the form you want.



7. A further example of the math facility — integrate — seen here as the integral of the signal between the cursors. A convenient display for use in “energy” measurements for example.

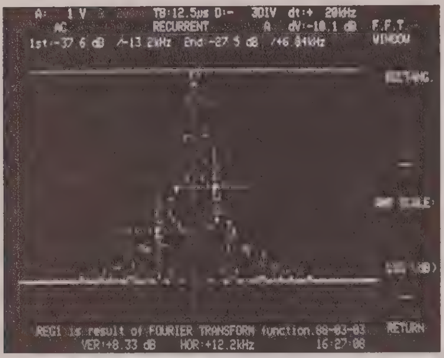


8. Further processing gives a new dimension to single shots buried in noise. These signals, unlike repetitive waveforms that can be “averaged” if noise exists, are once off. That means “average” cannot be used; however with post acquisition filtering, the true signal can be revealed.



9/10. To complement further the PM 3320A’s extensive processing capabilities, an FFT (Fast Fourier Transform) option is offered. This allows selection of various windows (rectangular, hanning, hamming) together with a linear or logarithmic scaling of amplitude, to view quickly your signal in the frequency domain through calculation and display of the power spectrum. PM 3320A is one of the few general purpose instruments to offer such all round performance. (See photo 10. next page)

PM 3320A


A: 1 V
TB:12.5µs D:- 3DIV dt:+ 20kHz
AC
RECURRENT
A dV:-10.1 dB
F.F.T.
1st:-37.6 dB /-13.2kHz End:-27.5 dB /+6.84kHz
WINDOW
RETANG.
RETURN
REG1 is result of FOURIER TRANSFORM function.88-03-03
VER:+8.33 dB HOR:+12.2kHz
16:27:08

10.

Specifications

Technical Specifications

CRT

Philips 180 mm rectangular tube with 16 kV acceleration potential and P31 phosphor (GH). 100 mm x 120 mm useful screen area. 80 mm x 100 mm for traces.
Readout: Three separate areas reserved for front panel setting information, register parameters on softkey menus
Graticule: Internal with % indications. Illumination continuously variable

Autoset

Sets display, text, vertical mode, horizontal mode and trigger coupling in a predefined position. Other parameters depending on signal so that available signals are correctly recorded and displayed.

Signal Acquisition

Sampling Type:
Real time 200 ns/div...360s/div.
Equivalent time 5 ns/div...100 ns/div.
Maximum Sample Rate:
Real time sampling 250 Megasamples/s.
Equivalent time 10 Gigasamples/s.
External clock 50 kilosamples/s.
Vertical Resolution:
10 bits or 0.1% of full scale
Voltage resolution: 50 microvolt

Maximum Horizontal Resolution:
Single channel (single shot)
200 ns/div...500 us/div: 512 samples/acquisition; 1 ms/div...360s/div: 4096 samples/acquisition
Single channel (repetitive or single scan)
5 ns/div...100 ns/div: 512 samples/acquisition; 200 ns/div...360s/div: 4096 samples/acquisition
Dual channel (single shot)
200 ns/div...500 us/div: 512 samples/acquisition; 1 ms/div...360s/div: 2048 samples/acquisition
Dual channel (repetitive or single scan)
5 ns/div...100 ns/div: 512 samples/acquisition; 200 ns/div...360s/div: 2048 samples/acquisition
Acquisition Time: Real time 10.2 x time/division (exclusive delay time). Equivalent time 2s for 5 ns/div. (input signal dependent)
10 ms for 100 ns/div. (99% probability of all samples being updated).
Sources: Channel A and channel B (both channels can be inverted before acquisition).
Modes: Channel A or channelB; Channel A and channel B; Channel A and channel B added. Average mode and min./max. mode possible in all three modes.
Sample Difference Between A and B: Both channels are sampled simultaneously ±200 ps.
Acquisition Processing:
Absolute min./max. (envelope)
Averaging
Save on difference
Stop on difference

Channels A and B

Input Impedance (High Z): 1 MΩ in parallel with 14 pF
Input Impedance (50Ω): V.S.W.R. 1.2:1 at 200 MHz
Maximum Input Voltage (High Z): 300V (DC + AC peak) at 1 MHz
Maximum Input Voltage (50Ω): 5V DC and r.m.s.; 50V AC peak. Protected against selection with unsafe voltage on input connector.
Deflection Coefficients: 5 mV/div...5V/div. in 1-2-5 sequence. (Continuous control between steps)
Error Limit (Variable Calibrated): Overall 2% Add 2% in min./max. mode
Dynamic Range: 10 divisions
DC Offset

	Range	Resolution
5 mV/div...20 mV/div.	±5V	5 mV
50 mV/div...200 mV/div.	±50V	50 mV
500 mV/div...5V/div.	±300V	500 mV

Shift Range: ±5 divisions
Frequency Response: DC...200 MHz (-3 dB) AC coupled lower 3 dB point with 50Ω input 10 Hz; AC coupled lower 3 dB point with high Z input 1 Hz. Bandwidth limiter reduces bandwidth to 20 MHz.
Risetime (0.35/Bandwidth): 1.75 ns
CMRR: 120:1 at 1 MHz; 25:1 at 50 MHz
Min./Max. Function: Accuracy for pulse longer than 3 ns is 50%. Reset time 20 ns
Average: Continuous average where:

$$\text{New Value} = \text{Old Value} + \frac{\text{New Sample - Old Value}}{\text{Constant}}$$

And constant is: 32 x in roll mode. 2...64 x in other modes.

Time Base

Modes and Time Coefficients:
Recurrent: 5 ns/div...5s/div.
Single shot: 200 ns/div...5s/div.
Single scan: 5 ns/div...5s/div.
Multiple shot: 200 ns/div...5s/div.
Multiple scan: 5 ns/div...5s/div.
Roll: 50 ms/div...360s/div.
Absolute min./max.: 5 ns/div...5s/div.
Stop/save on difference: 5 ns/div...5s/div.
Error Limit: In equivalent time mode ±1%. In real time mode ±0.1%
Save/Stop on Difference: Time between end of last comparison and ready for next 100-150 ms dependent on memory resolution
Absolute Min./Max: Auto resets after 100 acquisitions or after 10s whichever occurs last (can be switched off)

Triggering

Sources: Channel A, Channel B, External, Line and External events
Impedance: 1 MΩ in parallel with 14 pF
Coupling: Signal triggering AC, DC, LF rej., HF rej., Auto level or TVF. Events triggering TTL, ECL or adjustable v
Maximum Input Voltage: 300V (AC + DC peak), at 1 MHz
Triggering Sensitivity

	Up to 300 MHz	Up to 200 MHz	Up to 30 MHz
Channel A and B	3 div.	1 div.	0.5 div.
External	0.3V	0.1V	0.05V
External/10	3V	1V	0.5V

Slope: Positive, negative or dual slope

Level Range:
Channel A and B: 8 div.;
External: ±0.8V;
External/10: ±8V,
Any source in AUTO: related to p-p value

Frequency Range:
Trigger coupling in DC: DC...300 MHz;
Trigger coupling in AC: 10 Hz...300 MHz;
Trigger coupling in LF rej.: 50 kHz...300 MHz;
Trigger coupling in HF rej.: DC...50 kHz

Trigger Delay: Range:
-10...9999 divisions (200 ns/div...360s/div.);
-10...500 divisions (5 ns/div...100 ns/div.);
1...9999 events (max. frequency 5 MHz),
Internal delay after event count

Memory

4 memories of 4K x 10 bit-words each

Display

Sources: Register R0, R1, R2 or R3 in any combination

Expansion
Horizontal: In steps 1x...64x (8x in A vs B). Continuously between 1x and 2x
Vertical: 0.2x, 1x and 5x

Display Handling:
Smoothed;
Dots only;
Dot join;
All registers can be inverted
Position: ±5 div. horizontally and vertically from screen center for each register and/or individual trace.

Setting Memory

Memory Size: 250 front panel settings maximum
Functions: SAVE, INSERT or DELETE for storage or erasure of settings. RECALL, NEXT or PREVIOUS for recall of programmed settings.
Configuration: Front panel settings can be grouped as main and sub settings in order to reach a number of closed sequences each with an own number of steps.

Calculation Functions

All waveform calculations can be performed with results stored in different registers from source register. Original waveform needs never be affected.
Add
Subtract
Multiply
Divide
Differentiate
Integrate
Amplitude histogram
FFT (optional)
Digital filter
Filter: Breakpoint related to filter order and TB by (0.72/N+1)*f sample where N=filter order and f sample=sample rate (dependent on [TB*10]/memory depth).
FFT (option): Range of amplitude display 48.9 dB. Positive spectrum display resolution 2000 points single channel, 1000 points dual channel. Frequency resolution related by TB/10.24 DC point is mid-memory.
FFT Windowing: Rectangular, Hanning or Hamming with linear or logarithmic scaling
FFT Calculation Time: No windowing; linear display 6 secs; windowing and logarithmic display, 15 secs.

Cursors

Max. Horizontal Resolution: Single channel mode 1:4096; Dual channel mode 1:2048
Vertical Resolution: 1:1024
Read Out Resolution: 3 digits
Error Limit: ±2% of voltage; ±0.2% of time
Range: Visible part of signal

Measurement Capabilities

dV
RMS
Pk-Pk
Max
Min
dt
1/d
Delay
Rise/fall
Rise/fall-ECL
Overshoot
Preshoot
Mean
Absolute volts
Volts Ch-Ch
Volts Reg-Reg
Relative time
Relative volts
Rise/fall-VAR
Frequency
Period
Width
Duty
Phase
Time Ch-Ch
Time Reg-Regt

Calibration Output

Squarewave;
Internal impedance 50Ω;
Output voltage 1V;
Output current 20 mA;
Frequency 2 kHz

Interfaces (optional)

Interface board is available containing IEEE-488 or IEC-625 interface, RS 232C interface and a real time clock.

IEEE-488 (IEC-625): Busdriver. E2 (Three-state).
"Interface Function Repertoire"

Source handshake	SH1	Complete capability
Acceptor handshake	AH1	Complete capability
Talker	T5	Basic talker, Serial poll, Talk only and Unaddress if MLA.
Listener	L3	Basic listener, Listen only and Unaddress if MTA.
Service request	SR1	Complete capability
Remote/local	RL2	No local lock out
Parallel poll	PP0	No parallel poll
Device clear	DC1	Complete capability
Device trigger	C0	No controller
Default address	8J	No controller

RS 232C
Connector: RFI/EMI
Busdrivers: Data circuits Spacing "0" > +3V; Marking "0" < -3V (T x D and R x D lines) Control circuits ON> +3V; OFF< -3V (RTS, CTS, DSR and DTR lines)
Current Output: <10 mA
Impedance: Output 300Ω; Input 3 kΩ...7 kΩ
Voltage: Output -7V...+7V; Input -25V...+25V

Interface Function Repertoire
Baud-rate: 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600 or 19200 (input and output separately selectable)
Stop-bits: 1 or 2
Parity: odd, even or no
Length: 7 or 8
Transmission: Asynchrone, full duplex
Handshake: Software ENQ/ACK or XON/SOF; Hardware DSR/DTR or CTS/DTR
Serial Poll: ESC 7
Go to Remote: ESC 2
Go to Local: ESC 1
Device Clear: ESC 4
Device Trigger: ESC 8
Digital Plot (option /403 and /803)
Language: Selectable HPGL or Philips protocol dependent on plotter type
Plotter select: Philips PM 8153/1, PM 8153/6, PM 8154, PM 8155 HP 7450, HP 7475A
Pen select: Pen 1 for Ch A
Pen 2 for Ch B
Pen 3 for Register Ch A
Pen 4 for Register Ch B
Pen 5 for graticule and alphanumerics
Plot area: Softkey selectable
Dot Matrix Printer
Screen Dump: Compatible with Epson FX 80 and HP Thinkjet®
Drawing Area: 10 cm x 10 cm

Analog Output

Screen dump or register dump possible. Output voltage 1V horizontal and vertical (±3%). Pen lift TTL compatible. Plot time adjustable between 20 ms...2 sec per dot.

General Specifications

Power Supply

Nominal AC Voltage Range: 100...240V
Nominal Frequency: 50 Hz...400 Hz
Power Consumption: With options 160W nominal
Memory Backup for Settings and Traces: Two LR6 batteries are required

Mechanical Data

Height: 176 mm (6.9 in); 250 mm (9.8 in) with feet and pouch; 4E in 19-inch rackmount version
Width: 419 mm (16.5 in); 465 mm (18.3 in) with handle
Depth: 570 mm (22.5 in); 670 mm (26.4 in) with handle
Weight: 18 kg (39.6 lb) excl. accessories

Environmental Characteristics

Meets environmental requirements of MIL-T-28800C Type III Class 5, Style D.
Temperature: Operating 0°C...+50°C; Storage -40°C...+70°C
Maximum Humidity: 95% relative humidity
Maximum Altitude: Operating 4.5 km (15 000 ft); Non-operating 12 km (40 000 ft)
Vibration: Frequency 5 Hz...55 Hz. Max. acceleration 30 m/s2
Shock: 6 shocks each axis, half sine wave, pulse duration 11 ms, peak acceleration 300 m/s2. Bench handling. (MIL-STD-810 method 516, procedure V).
EMI: MIL-STD-461 Class B. VDE 0871 and VDE 0875.
Safety: The instrument meets the requirements of IEC 345 class I, VDE 0411 class I, UL 1244 and CSA 556B.

Included With instrument: 2, 10:1 passive probes, Blue contrast filter, Operating Manual

PM 3320A

Ordering Information

Model

January 1989 prices

PM 3320A 250 MS/s Digital Storage Oscilloscope	$8990

Optional Configurations

When ordering, select basic "PM" model desired from above, and substitute the configuration option number listed below as a suffix:

/003 Basic configuration	N/C
/013 Basic configuration, plus FFT	add 1000
/303 Basic configuration, plus 19 in. rackmount	add 280
/313 Basic configuration, plus 19 in rackmount and FFT	add 1280
/403 Basic configuration, plus IEEE-488/RS 232 interfaces and plotter drivers	add 1000
/413 Basic configuration, plus IEEE-488/RS 232 interfaces, plotter drivers, and FFT	add 2000
/803 Basic configuration, plus IEEE-488/RS 232 interfaces, plotter drivers, and rackmount	add 1180
/813 Basic configuration, plus IEEE-488/RS 232 interfaces, plotter drivers, rackmount and FFT	add 2280

Example, Ordering Configuration

To order the basic oscilloscope with rackmount and FFT, select:

	Model	**Price**
Oscilloscope	PM 3320A	8990
Configuration Option Suffix	/313	1280
Complete Model Number	PM 3320A/313	10270

Accessories (See page 53)

Passive Probes

PM 8911/09 500Ω, 10:1 Probe with readout, cable length 1 m (3 ft)	$125
PM 8912/09 5 kΩ, 100:1 Probe with readout, cable length 1 m (3 ft)	125
PM 8924/00 1:1 Probe, cable length 1.5 m (5 ft)	60
PM 8929/09 10:1 Probe with readout, cable length 1.5 m (5 ft)	90
PM 8929/19 10:1 Probe with readout, cable length 1 m (3 ft)	90
PM 8929/29 10:1 Probe with readout, cable length 2.5 m (8 ft)	90
PM 8931/09 20 MΩ, 100:1 Probe with readout	135
PM 9599/09 Set of VHF Attenutators	200

Active Probes

PM 8940/09Q High Voltage Isolation Amplifier with readout	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe with readout	1000

Other Accessories

PM 8917/003 Video Sync Separator and Line Selector	$550
PM 8956/001 Retrofittable IEEE-488 (GPIB) and RS 232 interface	985
PM 8977/00 Camera Adapter for stationary use	150
PM 8992/80 Accessory Pouch	45
PM 8991/04 Oscilloscope Cart	450
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9310/00 Collapsible Viewing Hood	12
PM 9311/00 Long Viewing Hood	85
PM 9381 Oscilloscope Camera	650
PM 2122/01 50Ω Coaxial Switch	680
PM 2195/09 Probe Switch 400 MHz	650
PM 2230/001 Series Instrument Drivers Software	590
PM 2240/001 TestTeam Software	925
PM 2260/001 Oscilloscope Signal Processing Software	800

Service and Support

Three-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3308

GPIB
IEEE-488

RS-232

NEW

PM 3308

PM 3308 40 Ms/s Compact Digital Storage Oscilloscope

- Bandwidth of 100 MHz
- 40 Ms/s maximum sample rate
- 8 kbytes deep acquisition memory
- 180 kbytes non-volatile RAMdisk for up to 99 waveform storage
- 22 cursor measurement functions
- Powerful mathematic processing capabilities
- Large flat electroluminescent display

High Performance and Portability

The new PM 3308 is the ideal DSO to meet advanced field service requirements. With very compact design, this advanced instrument offers a convenience and portability never before achieved in a high-performance oscilloscope. The lightweight, low profile package weighing only 14.5 lb (6.5 kg), has a convenient shoulder strap making it easy to carry and bring real DSO measurement power exactly where it is needed.

And there is another equally important side to this versatile instrument's capability — it has a performance that's more than a match for any full-size instrument in its class. PM 3308 offers no-compromise test bench functionality that meets the most stringent demands for signal capture, measurement and analysis facilities.

Advanced Technology Electroluminescent Screen

The electroluminescent screen, the first fitted to an oscilloscope, delivers an unmatched combination of exceptionally compact overall instrument construction and outstanding display performance. The 512 X 256 pixel screen module has a high resolution of 3 dots per mm. The completely flat screen is free of parallax errors and other non-linear distortions, while the wide viewing angle of 140 degrees allows the display to be read clearly at almost any working angle. Focus is guaranteed correct with no need for adjustment. Text and trace color is amber, very clear and easy-on-the-eye, with exceptional contrast against the black display background.

Clear Control Layout

Contributing to its simple, secure operation, the PM 3308 has a clear control-panel layout with keys grouped by type of function; for example, those controlling the display, time, triggering and vertical settings. Keys performing on-screen functions are light brown for instant identification and those for other functions are dark brown. Cursors, trigger levels, delays and other settings are conveniently and quickly controlled by a rotary-action dial with the selected function indicated by LEDs.

Clear On-Screen Information

The PM 3308's clear and steady electroluminescent display is divided into three separate areas for at-a-glance read-out.

The trace section has a clear 6.4 X 8.8 division graticule. An information area displays instrument settings and the results of measurements being performed. A third area is displayed when a softkey function is called, with a "pop-up" menu displayed temporarily over the right hand side of the trace section. Once the final selection has been made, the menu pops-down again for a clear view of the waveform.

The total display measures 192 x 96 mm.

Instant-Action Autoset

Like most other Philips oscilloscopes, the PM 3308 has a multi-function Autoset control that automatically sets timebase, amplitude and triggering so that an incoming signal is optimally displayed. This valuable function provides instant signal viewing and measurement capability.

Powerful Acquisition Performance

The compact dimensions and easy portability of the PM 3308 in no way force any compromise on signal-acquisition performance. Two signal inputs are provided, together with a third external trigger input. Bandwidth is a full 100 MHz at a maximum sampling rate of 40 Ms/s on one channel. Maximum acquisition memory is 8 kbytes with an 8-bit vertical resolution, providing a powerful combination of speed and measurement length for detailed signal capture. Even fast glitches and single-shot phenomena can be reliably caught with a glitch-capture capability down to 10 ns.

The 5 MHz bandwidth limiter can be used in low frequency applications to cut-out noise and moreover, unwanted noise can be reduced further with an averaging capability for up to an astonishing constant of 10,000 signal averages.

For slow response signals, a roll mode is included down to 1 hour/div, giving over 200 hours of recording time.

Trigger and Delay Capabilities

The PM 3308 can be triggered from different internal and external sources. In real-time sampling mode, pretrigger of up to one full acquisition record is possible; if the full 8 kbytes is used it allows a maximum pretrigger value of over 200 divisions. The delay after trigger facility delays the signal for up to 999 divisions, so you can zero-in on exactly the part of the signal you want to study.

Furthermore, in real-time sampling mode, the DC-trigger accuracy is an exceptionally high 0.8%, for precise determination of the trigger moment. This gives an accuracy comparable to timer/counters for single shot time interval measurements.

For signals that are very noisy or suffer from interference or distortion, the PM 3308 has a unique variable hysteresis trigger capability. This feature allows for a stable triggering of those signals usually difficult to trigger by effectively 'desensitizing' the trigger moment; not just low pass filtering but by a calculated decision on the digitized waveform. The hysteresis can be set at up to 50% of range.

On-Board Storage Memory

Additional versatility is provided by a non-volatile 180 kbytes RAMdisk, which provides a valuable storage facility for user data and instrument settings without the vulnerability of a removable mass storage system. Up to 100 traces can be stored for later analysis and comparison, or for down loading to a PC. Alternatively, up to 100 complete instrument settings can be stored — particularly valuable for repetitive testing. Combinations of traces and settings can also be stored, with automatic memory partitioning.

Powerful Signal Processing

No less than four separate traces can be displayed simultaneously: the normal input channels A and B, plus additional, computed traces resulting from operations such as addition, multiplication, division, subtraction, integration or differentiation. These math functions are standard on the PM 3308 and can be performed either directly on input channels via channel A or channel B, or on stored signals. With this on-board computing power, the PM 3308 can instantly provide complex calculated results such as signal energy and power. If desired, signal smoothing can be selected to reduce the effects of noise.

Cursor Measurements

An extensive range of easy-to-use cursor measurements makes it easy and quick to get exactly the required signal information. Facilities of the PM 3308 include a comprehensive selection of both vertical and horizontal measurements. Vertical measurements comprise:

- Voltage differences between cursors,
- peak-to-peak and RMS values,
- average DC levels and mean trace voltages,
- cursor-to-zero and reference-to-zero voltages,
- 10 to 90% of voltage between cursors,
- 50% voltage for 1/2 peak-to-peak component over area defined by cursors,
- maximum and minimum voltages between cursors,
- linear and log ratios of V and V_{rms} measurements of two signals.

Horizontal measurements allow even further analysis of waveforms, particularly with respect to time:

- Cursor-to-reference, showing the time difference between the cursors,
- cursor-to-trigger time difference,
- reference-to-trigger time difference,
- risetime,
- frequency and period,
- phase measurements.

All these measurements can be performed with an excellent resolution of up to 25 ns in a single shot. Up to four measurements can be performed on a single waveform or alternatively, measurements can be performed on up to four different waveforms at the same time. The result is a versatile and powerful facility for channel-to-channel measurements and comparisons of measured parameters.

These extensive, high resolution measurement capabilities allow the PM 3308 to easily replace separate instruments like precision multimeters and counters in any engineer's toolkit.

Powerful Signal-Display Functions

Versatile functions allow detailed signal display and examination, making maximum use of the available information. For example, for detailed viewing of a part of the trace, simply set the cursor on the section to be examined and zoom in. Also provided is a separate function which separates X-Y plots and traces made against the timebase.

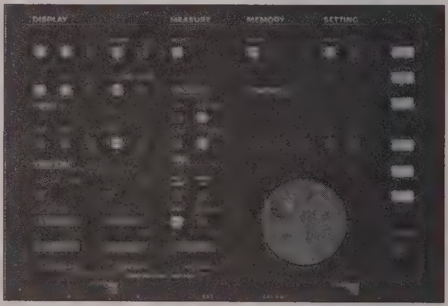
Gaps between samples can be filled by linear interpolation of the available displayed points. Sine interpolation can generate a best-fit sinewave for as few as three points, while simple pulse interpolation is also provided.

GPIB/IEEE-488 and RS 232C Interfaces Standard

Both GPIB/IEEE-488* and RS 232C interfaces are built-in as standard, providing maximum flexibility in interconnection. The IEEE-488 interface allows the PM 3308 to be used in automated test systems environments, while the RS 232C serial interface supports connection to a PC for easy down loading of measurement data or simple remote control of the instrument. In addition, both these interfaces can be used for direct connection to a digital plotter, providing instant hard-copy documentation of captured or computed waveforms.

***Information area:** displays the instrument settings and results from measurements*

- *The trace section has a clear 6.4 x 8.8 graticule*
- *This menu appears if a horizontal cursor measurement is selected. Once the final selection has been made the menu pops-down again for a clear view of the waveform*
- ***Trace 1:** Input from Channel A, Attenuator 8V/div*
- ***Trace 2:** Input from Channel B, Attenuator 2V/div*
- ***Trace 3:** Result of YA*YB, notice dimension*
- ***Trace 4:** Trace recalled from memory*
- *Timebase setting 1 ms/div.*
- *DC trigger level 0.0000V; source Channel A; AC coupled*
- *Voltage difference between cursor and zero-crossing on Trace 1*
- *Voltage difference between cursors on Trace 2*
- *Frequency of Trace 4*
- *Risetime of Trace 1*
- *Current date and time*
- ***Clear on-screen information:** three separate areas for at-a-glance readout. This display area measures 192 x 96 mm*



Clear control layout: keys grouped together by type of function; different colors for softkey functions.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Specifications

Technical Specifications

Autoset: Sets display, text, vertical mode, horizontal mode and trigger coupling in a predefined position. Other parameters are set depending on signal, so that signals at inputs are all correctly recorded and displayed.

Signal Acquisition

Sampling Type: Real time 1 µs/div...1 hour/div. (Half time resolution in dual channel operation at 1 µs/div). Equivalent time 10 ns/div...0.5 µs/div

Maximum Sampling Rate: Real time sampling 40 Megasamples/s in single channel operation; 20 Megasamples/s in dual channel operation. Equivalent time 4 gigasamples/s

Vertical (Voltage) Resolution: 8 bits or 0.4% of full range: 7 bits at 5 mV/div

Horizontal (Time) Resolution:
Single channel acquisition:
MaxMem off: 512 samples/acquisition
MaxMem on: 1 µs/div...1 hour/div at 8192 samples/acquisition;
10 ns/div...0.5 µs/div at 512 samples/acquisition
Dual channel acquisition:
MaxMem off: 512 samples/acquisition
MaxMem on: 1 µs/div...1 hour/div at 4096 samples/acquisition;
10 ns/div...0.5 µs/div at 512 samples/acquisition

Acquisition Time: In Real Time mode, time needed to acquire signal +250 ms. Minimum in Equivalent time 350 ms (Depends on input frequency)

Sources: Channel A and Channel B

Acquisition Modes: Channel A only; channel A and channel B; average; glitch detection

Time Skew Samples Channel A/Channel B: In Real Time, 25 ns; in Equivalent Time Simultaneous

Channels A and B

Input Connector: BNC with probe read-out

Input Impedance: 1 MΩ in parallel with 35 pF

Input Coupling: AC, DC or GND. (In GND position: channel input disconnected from BNC and connected to ground. Zero calibration of channels when both channels are grounded.)

Max. Input Voltage: 200V

Deflection Coefficient: 5 mV/div...5V/div in a 1-2-5 sequence of 10 steps. Error limit overall ±1.5%; up to memory ±1.5% (add ±3.5% in Equivalent time mode (2x at 5 mV/div)). Non linearity according to IEC 351 1.5%

Dynamic Range: ±6.2 div

DC Offset Control: -3 div...+3 div in 1/2 div steps

Frequency Response:
Lower transition point of BW:
Input coupling in DC position - DC
Input coupling in AC position - ≤5 Hz

Upper transition point of BW (-3dB):
In Equivalent time - ≥100 MHz
In Real time - ≥5 MHz; (^{z}source = 50Ω; channel input terminated with 50Ω)

Bandwidth Limiter: Starting point of HF rejection at 5 MHz (-3 dB); slope 6 dB/octave

Pulse Response: Rise time 3.5 ns (calculated from bandwidth x rise time = 0.35)

Common Mode Rejection Ratio: At 1 kHz, 100:1 (in Real-time); at 50 MHz, 10:1 (in Equivalent time)

Spurious Signals: Noise <0.25 div or 3 mV (whichever is greater). Add 0.15 div or 4 mV in Equivalent time

Glitch Detection Function: 100% detection of pulses with width 10...50 ns

Average: Constant 10, 100, 1000, 10000 in block or continuous mode

Cross Talk: <-40 dB at 1 MHz; <-30 dB at 50 MHz

Time Base

Modes: Recurrent, Single shot, Roll

Time Coefficients
In recurrent mode: 10 ns/div...200 ms/div
In single shot mode: 1 µs/div...200 ms/div
In roll mode: 500 ms/div...1 hour/div
Error limit: In Equivalent time mode ±3%; In Real-time mode 20 ppm/°C

Triggering

Sources: Channel A, channel B, EXT, EXT/10, line, manual

Input Connector: BNC

Input Impedance of EXT Trigger Inputs: 1 MΩ in parallel with 35 pF

Coupling: Internal DC; External DC, AC, LF rejected, HF rejected, AC-HF rejected, TVF

Mode: Recurrent auto, recurrent triggered

Max. Input Voltage: 200V(DC + AC peak)

Signal Trigger Sensitivity:
Channel A or B:
In Real time hysteresis setable from 1% (0.05 div) to 50% (3.2 div)
In Equivalent time at 100 MHz - ≤2 div
In Equivalent time at 20 MHz - ≤1 div (2x at 5 mV/div.)
EXT: at 100 MHz - ≤500 mV; at 20 MHz - ≤300 mV
EXT/10: at 100 MHz - ≤5V; at 20 MHz - ≤3V

Slope Selection: Pos or neg

Signal Level Control Range: Channel A or B ±(3.2 div-2 lsb); EXT ±2.5V; EXT/10 ±25V

Frequency Response
Lower transition point of BW:
Trigger coupling in DC position - DC
Trigger coupling in AC position - ≤5 Hz (-3dB)
Trigger coupling in LF REJ pos. - 30 kHz (-3dB)
Higher transition point of BW:
Trigger coupling in HF REJ pos. - 50 kHz (-3 dB)

Trigger Delay
Real time sampling mode:
Range if MaxMem off: -12.7...+999 div
Range if MaxMem on: -204.8...+ 999 div (ZOOM=1)
Equivalent time sampling mode:
Fixed delay of 1 div + approx. 35 ns; delay value measured in autocal sequence and displayed in divisions

Memory

Memory Size: Max. record depth 8 kbytes (4 kbytes per channel in dual channel); storage memory for traces and settings 180 kbytes

Functions: Write, Lock, Select

Display

Display Medium: 191.9 cm x 95.9 cm rectangular electroluminescent display with 0.275 mm x 0.225 mm pixel size

Display Modes: Up to 4 traces; definition of traces: Channel A, Channel B, memory, addition, multiplication, subtraction, division, integration, differentiation and smoothing; interpolations - linear, sine, pulse, off. Display expansion: horizontal (X-ZOOM) - 0.05x, 0.1x, 1x, 10x; vertical (separation) - 1x, 0.5x, 0.33x, 25x (depends on number of traces); X vs Y: trace 1 vs trace 2 and/or trace 3 vs trace 4; graticule: can be switched on/off; cursor and reference cursor: tracking on/off switch

Calculation Facilities

Number of Free Definable Measurements: 4

Sources: Trace #1, #2, #3, #4, trace #1/trace #2, trace #1/trace #3, trace #1/trace #4, trace #2/trace #3, trace #2/trace #4, trace #3/trace #4

Vertical Functions: Voltage difference, peak-peak, RMS, DC-level, mean, cursor-zero, reference-zero, voltage 10% to 90%, voltage 50%, MAX, MIN, ratio RMS (lin), ratio RMS (dB), ratio voltage (lin), ratio voltage (dB)

Horizontal Functions: Cursor-reference, cursor-trigger, reference-trigger, rise time 10% - 90%, frequency, period, phase

Cursor and Reference Cursor

Horizontal Resolution: In single channel mode 1 : 8192; in dual channel mode 1: 4096

Vertical Resolution: 1: 256

Read Out Resolution: 5 digits

Calibrator

Square Wave
Internal Impedance: 450Ω ±5%
Output Voltage: 5V ±3% (peak to peak)
Output Current: 10 mA ±5% (peak to peak)
Frequency: 1 kHz ±10%

PM 3308

Communication Interfaces

IEEE-488 Interface:
Type of Interface: ANSI/IEEE Std.488-1978
Connector: RFI/EMI shield connected to pin 12
Bus Drivers: E2 (Three-state)

Interfacing Function Repertoire:

Source handshake	SH1	complete capability
Acceptor handshake	AH1	complete capability
Talker	T5	Basic Talker Serial Poll Talk only Unaddress if MLA
Listener	L3	Basic Listener Listen only Unaddress if MTA
Service request	SR1	Complete capability
Remote local	RL1	Remote, Local, Local Lock-out
Parallel poll	PP0	No capability
Device clear	DC1	Complete capability
Device trigger	DT1	Capability
Controller	C0	No capability

Address: 0...30, indicator in EL display, default address 8
Source Handshake Timing: First source time (T_{sc1}) ≥2 µs, Source time (T_{sc}) ≥0.5 µs
Acceptor Handshake Timing: Accept time (T_{ac}) ≤0.65 µs, Ready time (T_{rd}) ≥0.02 µs

RS-232C Interface
Connector: RFI-EMI
Current Output: ≤10 mA
Impedance: Output 300Ω, input 3...7 kΩ
Voltage: Output 10...+10V, input -25...+25V

Interfacing Function Repertoire
Baud Rate: 50, 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600
Number of STOP-Bits: 1 or 2
Parity: odd, even or none
Character Length: 7 or 8
Transmission Mode: Asynchronous, full duplex handshake
Software XON/XOFF or OFF
Hardware DSR/DTR or CTS/DTR

Serial poll	ESC 7
Go to Remote	ESC 2
Go to Local	ESC 1, ESC 3
Device Clear	ESC 4
Device Trigger	ESC 8

Front Panel Control
Modes: Local, remote-locked
Push Buttons: Command and question
Continuous Control: Command and question
Probe Identification: Question only
Text on EL-Display Control: Command and question; modes: graticule On/Off; combined text: signal trace, settings read-out, cursors and calculation
Cursor Control: Command and question; resolving power 1:8192 max

General Specifications

Power Supply

Source Voltage AC (rms): Nominal 100...240V: limits of operation 90...264V
Source Frequency: Nominal 50...400 Hz: limits of operation 45...440 Hz
Maximum Power Source Interruption: At least 2 ms
Power Consumption (AC Source): Nominal 90 W

Other

Data and Settings Retention:
Memory Back Up Voltage: 2...<3.9V
Memory Back Up Current Drain: typically 130 µA
Batteries: 3pcs NiCd IEC: KR-15/51
Retention Time: typically 150 days
Temperature Range: 0...+55°C

Digital Plot Output
Connector: IEEE-488 or RS 232
Function: screen dump
Languages: HPGL and Philips GL
Paper Size: A3 (B) and A4 (A)
Real Time Clock: Display of seconds, minutes, hours, days, months (battery buffered). Year, century (remote controlled)
Autocal: Calibration of zero of both channels; determination of delay in equivalent time

Mechanical
Size: 122 mm H x 276 mm W x 410 mm D (4.8 in H x 10.9 in W x 16.1 in D)
Weight: 6.5 kg
Operating Position: Horizontal (standing on feet)
Cooling: Fan aided convection

Environmental

Temperature
Rated Range of Use: +15...+35°C (max. RH 75%)
Operating: 0...+50°C
Storage: -40...+75°C (EL-display -25...+70°C)

Maximum Humidity
Operating: 75% Relative humidity
Storage: 95% Relative humidity

Maximum Altitude:
Operating: 4.5 km (15000 feet)
Storage: 12 km (40000 feet)

Vibration (Operating):
Freq. 5...15 Hz: sweep time 7 min, excursion (pk to pk)
1.5 mm, max acceleration 7 m/s² (0.7g)
Freq. 15...25 Hz: sweep time 3 min, excursion (pk to pk)
1.0 mm, max acceleration 13 m/s² (1.3g)
Freq. 25...55 Hz: sweep time 5 min, excursion (pk to pk)
0.5 mm, max acceleration 30 m/s² (3.0g)
Resonance dwell: 10 min

Shock (Operating): Total 18 shocks, 6 on each 3 axes: shock wave form half sine, duration 11 ms, peak acceleration 300 m/s2 (30g)
Bench Handling:
Meets requirements: MIL-STD-810 method 516, proced. V, Salt atmosphere, structural parts meet requirements: MIL-STD-810 method 509, proced. I, salt solution 20%
Safety: Meets requirements of: IEC 348 Class I
Included with Instrument: One 10:1 10 MΩ passive probe with read out, operating manual, programming manual

Ordering Information

Model

January 1989 prices

PM 3308/003 100 MHz Flat Display Digital Storage Oscilloscope	$7500

Accessories (See page 53)

Passive Probes

PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8924/20 1:1 Probe, cable length 8 ft (2.5m)	60
PM 8926/29 10:1 Probe, cable length 8 ft (2.5m)	80
PM 8933/101 10:1 Probe, cable length 5 ft (1.5m)	100

Active Probes

PM 8943Q FET Probe	850
PM 8940/09Q High Voltage Isolation Probe	850
PM 9355/09Q AC Current Probe	1000

Other Accessories

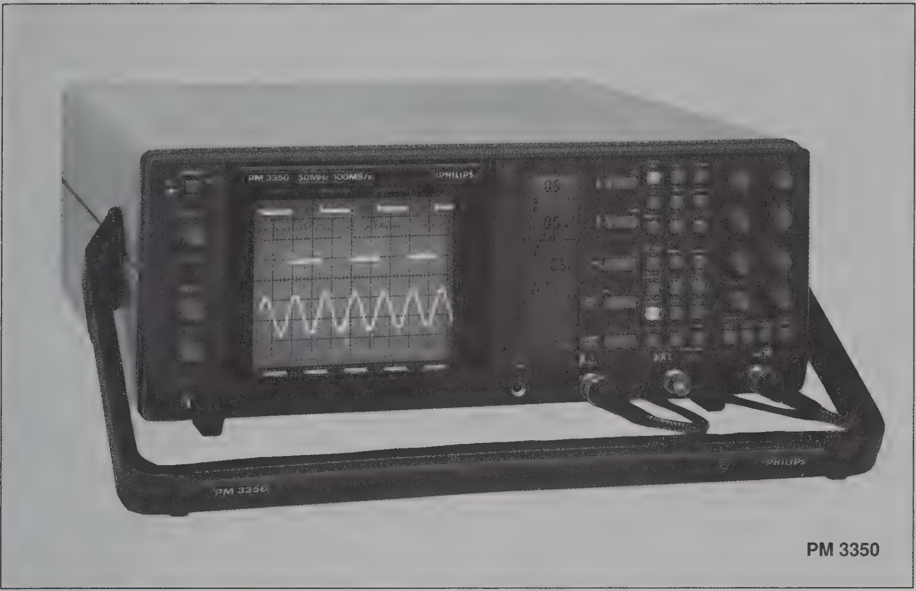
PM 9051 BNC to 4 mm Banana Binding Posts	9
PM 2295/05 IEEE-488 cable length 1.5 ft (0.5m)	150
PM 2295/10 IEEE-488 cable length 3 ft (1m)	155
PM 2295/20 IEEE-488 cable length 6 ft (2m)	170

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3350 & PM 3365

GPIB
IEEE-488

RS-232



PM 3350

PM 3350 50 MHz, 100 MS/s Advanced Digital Storage Oscilloscope

- Dual digital and analog oscilloscope functionality in one
- Simultaneous sampling on both channels up to a high 100 MS/s
- 50 MHz analog bandwidth
- Triggering up to 100 MHz
- Autoset for instant on-screen trace display in both operating modes
- Cursors for measuring dV, dt, automatic rise/fall time, frequency and amplitudes
- Deep 4k reference memory for direct waveform comparison
- Interface options for remote control or screen hard copy via plotters or printers

Analog and Digital

The PM 3350 is the answer to many DSO measurement requirements, offering a combination of the best of real-time and digital storage oscilloscope technology. PM 3350 is designed as a high power digital storage scope for capture and analysis of single events and repetitive signals. It also has real-time capabilities that are needed or convenient in some applications, with an analog bandwidth of 50 MHz. (And the PM 3365, on page 43, expands this to 100 MHz, while adding other significant product enhancements.)

As a true "combi-scope", the PM 3350 is not simply an anolog scope with "add-on" digital features, but rather is a fully implemented DSO with real-time capability. The PM 3350 sampling rate "benchmark" is a very high maximum 100 Msamples/s for each channel simultaneously. This high sampling frequency allows storage of fast signals with excellent resolution. Maximum single event resolution is 10 ns.

Analog Shift Register

The PM 3350 uses a P^{2}CCD (or Profiled Peristaltic Charge Coupled Device), a solid state combination of a fast track-and-hold input circuit and an analog shift register. Momentray values of input signals in analog samples are captured with intervals as short as 10 ns (100 Msamples/s clock). After triggering, these samples are presented to an accurate, successive approximation A/D at a much slower 100 ksamples/s. Digitizing is thus internally a low frequency operation, giving high resolution, yet not sacrificing the very high data capture rate of 100 Msamples/s. This ensures single shot events are captured and displayed to a bandwidth of over 10* MHz, such as in destructive testing or power device switching transients. Indeed, the fast sampling rate of PM 3350 brings an unparalleled break-through in DSO performance in this price range.

Simultaneous Sampling

Unlike many DSO's in the PM 3350's class, the maximum sample rate is maintained even when both channels are in use. It's essential that sample rate is not reduced in two channel acquisition, because sample rate determines the effective single shot bandwidth, and this is one of the critical specifications for a DSO. The PM 3350 offers full 100 MS/s on both channels simultaneously, which also means no time errors are caused by sample multiplexing in capture from channel to channel. Furthermore, the resolution is maintained at a very high 10 ns.

Extending single shot applications further, the PM 3350 incorporates a multishot capability, thanks to its expanded memory, as described below.

Deep Memory

A lower timebase settings, signals measured at speeds up to 5 ms/div, are stored in a 4kbytes x 8-bit memory. Data from the memory can be transferred to a second 4kbytes x 8-bit memory by one keystroke, permitting separate storage of channels A and/or B. This allows storage and display of reference waveforms while at the same time, capturing and displaying live signals from the device under test. Up to 4 traces may be stored and displayed at any one time.

This expanded memory has the added benefit of allowing multishot signal capture and display. The second reference memory effectively doubles single shot memory dept, by first capturing a single shot in the acquisition memory. Then it is dumped into the reference memory. The scope re-arms and takes the next incoming signal, so capturing 2 events. These signals may be close in time (within 50 ms) or may be many hours apart. Combined with the high sample rate, this flexibility is a great help in tracking down elusive intermittent faults.

Low Frequency Signal Registration

As well as fast signal capture, the PM 3350 has a roll made with sweep speeds down to 50 s/div giving a visual display lasting 8 minutes, allowing low frequency phenomena to be studies. The signal can be frozen at any time by pressing a single button. This is useful for study of chemical or biological reactions and responses, for example, or for slow mechanical "wear and tear" cycling. In fact this roll facility, can be used in a similar way to a paper and pen recorder.

Triggering Functions

The PM 3350 has a selection of powerful trigger capabilities, including Automatic, Manual and Single shot settings. In addition, microcomputer control supplies a built-in intelligence that completely eliminates operator adjustment in auto-triggering mode, making operation simpler and more accurate. TV line and frame for positive and negative video, alternate, auto P-P or DC, ext. and line trigger are all included in the triggering facilities, which has a wide 100 MHz bandwidth.

With 10 datapoints/period.

PM 3350 & PM 3365

Pre-trigger and Post-trigger Delay Capabilities

A major advantage of a digital storage scope is its ability to define precisely the portion of the waveform to be captured before or after the trigger. The PM 3350 has a pre-trigger capability of up to 10 divisions, allowing events leading up to the trigger moment to be captured and viewed. For example in transient waveforms, the whole of the leading edge may be recorded rather than just from the trigger moment on. This capability prevents signal detail prior to the trigger moment from being missed and is an important feature in the analysis of destructive tests. Furthermore, the PM 3350 has a capability of posttrigger (i.e. the time delay after the trigger point) for up to 250 divisions. Thus, records of over 25 screens width of information can be captured and displayed.

Low Level Signals

In mechanical applications where very low level signals are not unusual, the 2 mV/div facility allows direct input to the memory from, for example, a transducer.

X-Y Displays

Analog mode can be used for the display of X-Y diagrams. Filter curves, lissajous figures and other similar phenomena which are not time-related, but have other reference voltages, can be displayed for further analysis.

GPIB/IEEE-488 or RS 232C Interface

Signal transfers between the PM 3350 and a controller are possible via GPIB/IEEE-488* or RS 232C interfaces, for data processing, digital plots and mass storage.

Documentation and Hard Copies

The PM 3350 has several options for making hard copies of waveforms, with a built-in analog output to drive an X-Y recorder. A pen lift control is also provided. Digital plotters can be driven directly via the optional IEEE-488 or RS 232 ports. Philips PM 8155 and HPGL compatible plotters are supported by the PM 3350. The interfaces port is directly compatible with some dot-matrix printers, such as the Epson FX 80 HP Thinkjet® and compatibles.

® HP Thinkjet is a registered trademark of the Hewlett Packard company.

Ergonomic Design

Much attention has been paid to the operator interface on the PM 3350. All the innovations on the Philips 60 MHz and 100 MHz oscilloscopes are utilized in the PM 3350, resulting in a front panel layout that is much clearer, simpler and easier to use than on conventional scopes. Significant and new features are:

- LCD panel for direct read-out. The LCD panel is directly alongside the screen and gives a clear, at-a-glance alphanumeric read-out of settings, eliminating the need to look at control positions set on a crowded textplate.
- Fast-action up/down controls. Ranges and settings are entered by fast, fingertip-action controls.
- Menu-driven softkeys. Functions such as timebase and trigger settings are softkeyed, with a step-through function sequence. Selected functions are clearly indicated at all times on the LCD panel.
- Logical panel layout. Variable settings like Y-pos. and X-pos., trigger levels and hold-off are grouped together on the right of the front panel; display settings are grouped on the left of the CRT. The result is a clear panel layout that simplifies and speeds operation.

Autoset

Accessed by a single button, this function allows instant setting of all scope parameters for any input signal, eliminating time-consuming manual range finding and fine adjustment. AUTOSET operates in the Digital Storage mode, as well as when operating in the Real Time mode. Combined with the ergonomic design, the PM 3350 really offers true ease of use.

Signal Handling

The PM 3350 features extensive signal handling and measurement capabilities. It has clear on-screen softkey menu structures that permit quick access to a wide variety of measurements, by means of two independent cursors. These cursors allow the usual dV (voltage difference between cursors) to be performed, and further extend the range of automatic measurement facilities. In addition, the cursors offer measurements of signal frequency, rise and fall times and peak-to-peak voltage of the captured waveform, and can be performed live.

Other signal handling capabilities include a unique function called "RESTART". This function allows the user to zero in on a specific part of the signal, simply by positioning the cursors on either side of the portion of the waveform of interest and pressing the RESTART key. The result is the reacquisition of the signal at full resolution (not just expansion which yields no further signal information), with a digital delay and timebase calculated from the position of the cursors. To complement the signal handling, there is a further signal expansion possibility up to a factor 32.

Modular Design, Easy Service

The modular design and construction of the PM 3350 DSO provides exceptional component accessibility, making service fast, simple and low-cost. Swing-up PCBs allow easy access and removal is straightforward, due to the plug-in flat ribbon cable connections. Repairs in the field are quickly performed by simply replacing damaged modules. A complete, built-in software-driven test routine assures correct operation within minutes via on-screen test displays with instruction text.

Automatic testing

The modular construction brings another benefit - thorough testing, at module level for the first time, before building into a complete instrument. Each module passes through a computerized test station where it is given a complete functional test and adjustments are made. There is thus no chance of a complete instrument containing a faulty module. As a check, complete instruments have to pass a test routine, an extended burn-in period and then, a final series of tests. Thus, through such a rigorous test procedure, last minute defects are eliminated ensuring a long, trouble-free service life for the instrument.

Specifications and Ordering Information — see PM 3365

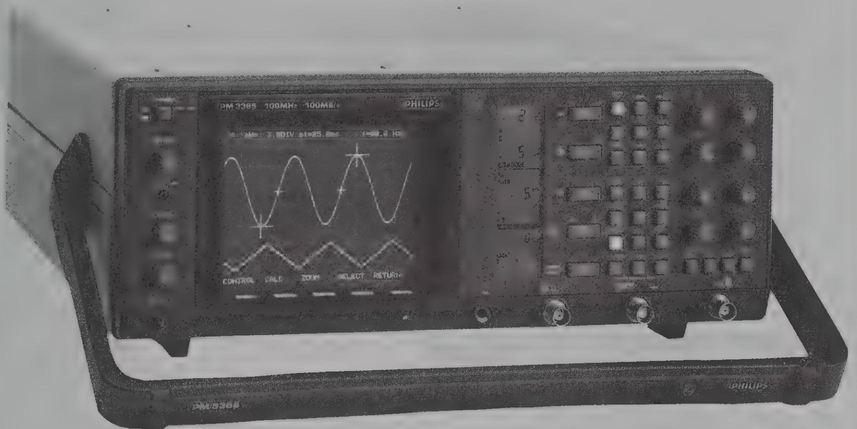
The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 3350 & PM 3365

GPIB
IEEE-488

RS-232

NEW



PM 3365

PM 3365 100 MHz, 100 MS/s Advanced Digital Storage Oscilloscope

- Dual digital and analog oscilloscope functionality in one
- Full PM 3350 performance, including simultaneous 100 MS/s sampling on both channels, deep memory and AUTOSET
- Analog and digital repetitive bandwidth to a full 100 MHz
- Systems compatability
- Triggering up to 150 MHz for improved stability
- Advanced cursors for automatic measurements of RMS, Vpp, Mean, Absolute, Frequency, Period, Pulse Width, and Rise/fall time
- Dual timebase referencing, with Autozoom

The PM 3365 brings additional DSO and real-time functionality to the PM 3350 range of oscilloscopes. It offers all the same capabilities as found in the PM 3350 - Roll mode for low frequency signal capture, the same single shot capture facilities and the same ease of use. But the PM 3365 now adds more through higher bandwidth, repetitive sampling and more capture and analysis power. The PM 3365 is the big brother of the popular PM 3350, a DSO for extended applications.

Double Performance

The new PM 3365 extends the performance standard for the popular 'combi-scope', the term which describes a full capability Digital Storage Oscilloscope and conventional analog real time scope in one unit. A high performance 100 MHz bandwidth for both analog and digital operation is complemented by a fast 100 MS/s sampling rate, the same as for the PM 3350, for single shot capture resolution of 10 ns. This combination gives exceptional capture and analysis capabilities to crack tough measurement problems.

With its advanced features, the PM 3365 is a powerful systems instrument, offering all the advantages of digitizing: long term storage of waveforms for future reference; transfer of waveform data; and automatic waveform parameter extraction, either internally through the PM 3365's built-in measurement calculations or externally via a remote systems controller.

Repetitive Sampling

While the sample rate determines the single shot capabilities of a DSO, sequential repetitive sampling is needed to digitize recurrent signals up to the full 100 MHz bandwidth. Here the digitized signal is built up over successive sweeps of the incoming signal; on each sweep a sample is taken until the memory is completely filled and the cycle begins again. The PM 3365 uses this sequential sampling technique to provide a 100 MHz capture bandwidth, mirroring the analog capabilities. All the benefits of digitized signals can then be harnessed to give measurement and analysis capabilities to 100 MHz and beyond, including constant light output over all timebase ranges even at 20 ns/div. With an equivalent time sample rate of 2.5 Gs/s, expansions up to x32 enable small signal details to be accurately examined.

Sensitive To Your Needs

The input sensitivity of PM 3365, over the full 100 MHz bandwidth, cover almost every application. This gives µV resolution in results, pinpointing those small signal variations. Couple this with a 1.2 division trigger sensitivity at 100 MHz and you have stable wideband low level signal capture. If you want even more speed, the trigger capabilities are specified all the way up to 150 MHz and you have in addition all of the excellent trigger facilities as found in the PM 3350.

Advanced Cursors

Analysis of captured signals couldn't be easier than with the PM 3365. As for the PM 3350, the same independent cursor control allows you to position two cursors to perform measurements on exactly the part of the waveform of interest. With signal tracking cross-hair cursors, parallax errors and the inconvenience of manual measurements are eliminated. No calculations are needed; signal voltages and time differences are read directly from the crisp, clear display and the PM 3365 adds the all important pulse characterization measurements including signal frequency, period, pulse width and rise and fall times. Amplitude can be measured as peak-peak, RMS, mean and absolute voltage referenced to signal ground.

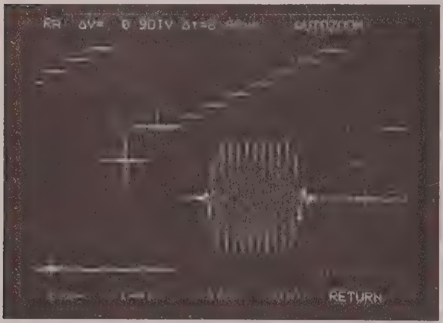
This advanced performance is easily accessed, through intuitive softkey menus, and simply executed in most cases with a single push of a button. Remote control allows access to distributed computing power; the scope will itself analyze trace data for waveform measurements and return the result.

Delayed Timebase Referencing

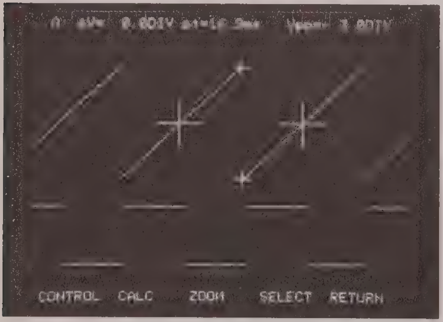
When examining fine detail within a signal cycle, it is necessary to expand the section of interest while maintaining a complete cycle display. Analog scopes do this by delayed sweep, where the main timebase (MTB) is slow and the delayed timebase (DTB) follows at a much faster speed, to give greater time resolution on a specific part of the signal. To see any part of the wave in detail and not just a portion from the trigger point on, the second timebase sweep is delayed by a user-specified time interval relative to the MTB. The time reference of the detailed part to its position in the cycle is displayed on the MTB waveform by an intensified zone.

PM 3350 & PM 3365

In the PM 3365, a similar function is available with the AUTOZOOM feature. A waveform is stored in the reference memory and displayed on screen, and acquisition takes place over a portion of the waveform, defined by cursors positioned by the user on the reference. If the cursors are moved towards each other, the acquisition timebase is automatically increased or 'zoomed' and so resolution and sample rate are higher only in the area between the cursors. For examination of any point, both cursors can be tracked together left and right across the screen over the reference trace, delaying acquisition to that point. This innovative delayed timebase referencing makes signal capture and analysis fast, efficient and simple.



Delay Time Referencing enables a burst within a video signal to be examined while still displaying the complete signal. This is directly equivalent to the delayed timebase function on an analog oscilloscope.



Automatic Pk-Pk measurement between main cursors. The secondary cursors indicate where the positive and negative peak measurement is made.

Complete Ease of Use

All the PM 3365 functions are easy to use in all applications as the same logical control found in the PM 3350 is used in the PM 3365. The AUTOSET push button gives instant, optimal display of any input signal. The familiar and separate, clear LCD gives all relevant set-up information, so there is no searching of a crowded front panel.

Ease of use also comes through clear menu structures and softkey positioning on screen. You can keep your attention focused on the trace even when performing tasks such as cursor measurements. Making hard copies is still as easy with the choice between RS 232 and IEEE-488 interface options. Hardcopy to digital plotters using the HPGL and Philips GL protocols, and on printers such as the Epson FX80 and compatibles, and the HP Thinkjet is supported and accomplished at the touch of one single button.

Either interface also allows simple application in systems environments. Complete system control of all main scope functions is possible by the use of simple programming commands.

No matter what your application, PM 3365 not only offers very powerful, advanced functions but is easy-to use. These characteristics make it the ideal instrument for use in development and production environments.

Specifications

Technical Specifications

All specifications are valid for PM 3350 and PM 3365 except where expressly stated otherwise.

Analog Mode

Vertical display modes: YA, YB, InvertB, A+B, A B (ALTernate or CHOPped)
Frequency response:
PM 3365: DC...>100 MHz -3dB

PM 3350: DC...>50 MHz -3dB
(20mV/div...10V/div)
DC...>35 MHz -3dB
(2mV/div...10mV/div)
In AC lower 3dB point is <10 Hz
Risetime:
PM 3365: <3.5 ns (2mV/div...10V/div)
PM 3350: <7.0 ns (20mV/div...10V/div)
<10 ns (2mV/div...10mV/div)
Pulse aberrations: <1.5 sub. div. peak to peak (input pulse 5 div. 1 ns rise)
Deflection coefficient: 2mV/div...10V/div in 1,2,5 sequence
Error limit: ±3% continuous control between steps with > flashing in LCD as warning symbol for uncal. setting
Input impedance: 1 MΩ ± 2%; 20 pF ± 2 pF
Max. input voltage: 400V (DC + AC peak)
Dynamic range: >24 div. at 10 MHz
>8 div. at 100 MHz (PM 3365)
>8 div. at 50 MHz (PM 3350)
CMMR: 100:1 at 1 MHz
Horizontal display modes: Timebase, or XY displays using YA and/or YB (vertical) and YA, YB or Ext. (horizontal)
Timebase: 0.5s/div...50ns/div in steps of 1,2,5 sequence
Expansion: x10, fastest sweep speed 5ns/div
Error Limit: ± 3%, in x10 ± 4% continous control between steps with > flashing in LCD as warning symbol for uncal. setting

Triggering

Trigger modes: Auto (free run), non auto triggered, single sweep
Trigger sources: A,B, composite (A,B), Ext. (DC or AC), Line LCD indicates not triggered, triggered or armed status
Trigger coupling: Auto peak - peak (P-P), DC, TVF, TVL
Trigger sensitivity:

PM 3365

	Int.	Ext.
10 MHz	0.5 div	50 mV
100 MHz	1.2 div	150 mV
150 MHz	2.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level Range	±8 div	±800 mV

PM 3350

	Int.	Ext.
10 MHz	0.5 div	50 mV
50 MHz	1.0 div	150 mV
100 MHz	3.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level range	±8 div	±800 mV

Slope pos (+) or neg (-), TVF or TVL pos (+) or neg (-) video

Level view: ±4 divisions (voltage indication in LCD)
Error limit: ±0.3 divisions

X-Deflection

Deflection coefficient: via Ch A or Ch B 2mV/div...10V/div
Freq. response: DC to 2 MHz
Error limit: ± 5%
Phase shift: <3 degrees (at 100 kHz)
Ext. input impedance: 1 MΩ ± 2%; 20 pF ± 2 pF
Max. input voltage: 400V (DC + AC peak)

Digital Mode

All specifications equal to analog part unless otherwise stated
Vertical Resolution: 8 bits
Display modes: YA,YB, Invert B
Frequency response:
PM 3365: DC...>100 MHz -3dB
(2mV/div...10V/div)
repetitive sampling to full bandwidth
PM 3350: DC...>20 MHz -3dB
(2mV/div...10V/div)
real time sampling only
Horizontal Display modes: Recurrent, Single shot, Multiple shot (up to 2), Autozoom (PM 3365 only)
Timebase Recurrent:
PM 3365: 0.5s/div...20 ns/div
(repetitive sampling)
PM 3350: 0.5s/div...0.5µs/div
(real time sampling only)

Single shot, Multiple shot: 0.5s/div...0.5µs/div
Roll: 50s/div...1s/div
Timing accuracy: ± 0.1%
Display expansion: x1...x32

Horizontal Resolution

Single channel:

50s/div...5ms/div:	4096 samples/acquisition
2ms/div...0.5µs/div:	512 samples/acquisition
2ms/div...20 ns/div:	512 samples/acquisition (PM 3365 only)

Dual channel:

50s/div...5ms/div:	2048 samples/acquisition
2ms/div...0.5µs/div:	512 samples/acquisition
2ms/div...20ns/div:	512 samples/acquisition (PM 3365 only)

Signal Acquisition

Maximum sample rate: 100 MS/s, synchronously for both channels
Equivalent time sample rate: 2.5 GS/s (PM 3365 only)
Trigger delay:
PM 3365: 10 divisions of pre-trigger
2500 divisions of post-trigger
PM 3350: 10 divisions of pre-trigger
250 divisions of post-trigger
Display expansion: x1...x32 horizontal

Memory

Storage registers: 2
No. of traces stored in each register: up to 2
Depth of acquisition memory: 4096 words
Depth of reference memory: 4096 words
Vertical resolution: 8 bits
Display modes: Ch A, Ch B, Reg B in any combination

Cursors

Horizontal Resolution
Single channel: 1:4096 over 10 divisions
Dual channel: 1 x 2048
PM 3350: 2ms/div...0.5ns/div; 1:512
PM 3365: 2ms/div...20ns/div; 1:512 (1:1024 in dot join)
Vertical resolution: 1:256 over 10 divisions
Read out resolution: 3 digits amplitude and time
Calculation functions:
PM 3365: dV, Vpk-pk, Vrms, Vmean, Vabs dt, Freq, Period, Pulse-width, Rise/fall time
PM 3350: dV, Vpk-pk, dt, 1/dt, Freq, Rise/fall time

Interface Alternatives

Analog output for XY recorders
Output level: 1 V/full memory ± 2%
Penlift: TTL (0 or 1)
Plot time/sample: 20ms...2000ms (softkey selectable)

Connector: 9 pin DIN, female
Functions: memory dump, register selectable
Output sequence: channel A first

Interface IEEE-488 (option 40)
Bus driver: E2 (three state)
Functions available: SH1, AH1, T5, L3, SR1, RL2, PP0, DT1, DC1, C0

RS 232C (option 50)
Handshake: Software XON/XOFF
Hardware DSR/DTR and CTS/DTR
Baud rate: Transmit 75...19200
Receive 75...1200
Stop bits: 1 or 2
Parity: Odd, even or no
Character length: 7 or 8 bits

Digital plot (option 40 or 50)
Language: Selectable HPGL or Philips protocol dependent on plotter type
Plotter select: Philips PM 8153/1, PM 8153/6, PM 8154, PM 8155 HP 7450, HP 7475A
Pen select: Pen 1 for Ch A
Pen 2 for Ch B
Pen 3 for Register Ch A
Pen 4 for Register Ch B
Pen 5 for graticule and alphanumerics
Plot area: Softkey selectable

Dot Matrix Printer
Screen Dump: Compatible with Epson FX80 graphics protocol or compatible, and HP Thinkjet
Drawing Area: 10 cm x 10 cm

General Specifications

Miscellaneous Display: CRT with 8 x 10 cm viewing area P31 phosphor, 16 kV acceleration voltage. Parallax free graticule with continuously variable illumination. Separate LCD for display of status information, settings etc. LCD is constantly backlit. Softkey display are on CRT for selection of menu choices.

Power supply

Line voltage range: 100V...240V AC ± 10%
Line frequencies: 50Hz...400Hz ± 10%
Power consumption: 70W

Mechanical Data

Width: 387 mm (15.2 in) incl. handle
350 mm (13.8 in) excl. handle
Length: 530.5 mm (20.9 in) incl. handle and knobs
518 mm (20.4 in) incl. handle excl. knobs
455.5 mm (17.9 in) excl. handle incl. knobs
433.5 mm (17.1 in) excl. handle and knobs
Height: 146.5 mm (5.8 in) incl. feet
134.5 mm (5.3 in) excl. feet
Weight: Approx. 9.5 kg (20.9 lbs) excl. accessories

Environmental Data

The PM 3350/65 are designed to meet the requirements of MIL-T-28800 C, Type III, Class 5, Style D

Temperature
Rated Range of use: +10°C...+40°C
Limited Range of Operation: 0°C...+50°C
Storage: -40°C...+75°C

Altitude
Operating: 15,000 ft (4,500 m)
Non-operating: 40,000 ft (12,000 m)
Humidity: 95% RH
EMI: MIL-STD-461 CLASS B VDE 0871 VDE 0875 Grenzwert klasse B
Safety: Meets requirements of IEC 348 Class 1, VDE 0411, UL 1244, CSA 556 B
Shock: Operating and Non-operating: 30 g, $^1/_2$ sine, 11 ms duration, 6 shocks in each direction (3 each face), for a total of 18 shocks
Vibration: 5...55 Hz, 15 minutes along each of three axes, with a maximum acceleration of 3 g Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found
Bench handling: MIL-STD-810 method 516, procedure V

Included: 2x PM 8926/09 Passive 10:1 probes with 5 ft (1.5 m) cable and scale factor readout, Blue CRT contrast filter, Operating Manual

Ordering Information

Models

January 1989 prices

PM 3350 100 Ms/s, 50 MHz Digital Storage Oscilloscope	$3990
PM 3352 Same, with rackmount	4115
PM 3365 100 Ms/s, 100 MHz Digital Storage Oscilloscope	4990
PM 3367 Same, with rackmount	5115

Optional Configurations

When ordering, select the basic "PM" model from above, and add the configuration option number listed below as a suffix.

/003 Basic configuration	N/C
/403 Basic configuration, with IEEE-488 interface	add 500
/503 Basic configuration, with RS 232 C interface	add 500

Example, Ordering Information
To order a 100 MHz, 100 Ms/s Digital Storage oscilloscope in rackmountable configuration, with GPIB/IEEE-488 interface installed, select:

Basic oscilloscope	PM 3367	$5110
Configuration option suffix	/403	500
Complete model number	PM 3367/403	5610

PM 3350 & PM 3365

Accessories (See page 53)

Passive Probes

PM 8922/501 1:1 or 10:1 Probe, cable length 5 ft (1.5M)	$50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5 m)	60
PM 8924/20 1:1 Probe, cable length 8 ft (2.5 m)	60
PM 8926/09 10:1 Passive Probe with readout, cable length 5 ft (1.5 m)	80
PM 8926/29 10:1 Passive Probe with readout, cable length 8 ft (2.5 m)	80
PM 8926/501 10:1 Probe, cable length 5 ft (1.5m)	50
PM 8926/591 10:1 Probe with readout, cable length 5 ft (1.5m)	60
PM 8931/09 20 MΩ, 100:1 Passive Probe with readout	135
PM 8936/09 Set of two 8926/09	125

Active Probes

PM 8940/09Q High Voltage Isolation Amplifier with readout	$850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe with readout	1000

Other Accessories

PM 8917/003 Video Sync Separator and Line Selector	550
PM 8957 Retrofittable GPIB IEEE-488 Interface	500
PM 8958 Retrofittable RS 232C Interface	500
PM 8988 Protective Front Panel Cover	35
PM 8991/04 Oscilloscope Cart	450
PM 8992/65 Accessory Pouch	45
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9076/01 DIN - 4 mm Banana Analog Plot Out Cable	60
PM 9076/02 DIN - Amphenol Analog Plot Out Cable	$60
PM 9381 Oscilloscope Camera	650
PM 2195/09 Probe Switch, 400 MHz	650
PM 2122/01 50Ω Coaxial Switch	680
PM 2230 Series Instrument Driver Software	590
PM 2240/001 TestTeam Software	925
PM 2260/001 Oscilloscope Signal Processing Software	800

Service & Support

Warranty

Three-year product warranty. See page 470 for further information on warranty terms and definitions.

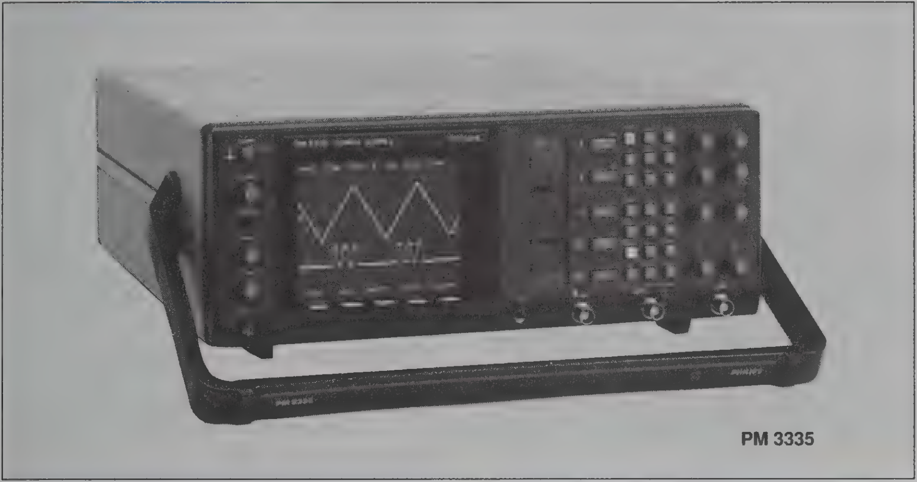
Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3335

GPIB IEEE-488

RS-232

NEW



PM 3335

PM 3335, 50 MHz, 20 MS/s Digital Storage Oscilloscope
Analog oscilloscope plus full function Digital Storage Oscilloscope
20 MS/s sample rate on each channel simultaneously
50 MHz real time analog bandwidth
Deep 8 kbytes x 8-bit waveform acquisition memory even at max. sample rate
Second reference memory for comparison of waveforms
AUTOSET for instant on-screen trace display
Standard cursors for many on-screen measurements
GPIB/IEEE-488 and RS 232 interface options

Two Scopes in One

Philips new PM 3335 sets a standard in performance and economy. This instrument is two professional scopes in one: it operates as a real-time 50 MHz analog oscilloscope and at the touch of a button, becomes a full function digital oscilloscope for advanced applications. Now, for the first time in a cost-effective scope, you have the power for digital capture and analysis of elusive single shots with a full 20 MS/s sample rate on each channel simultaneously. Unlike some scopes in this class, the full sample rate is maintained for all channel combinations, giving a single event resolution of 50 ns for both channels. Repetitive signal analysis is also possible up to 50 MHz in analog oscilloscope mode. A x10 expansion allows 5 ns sweep speeds for detailed viewing and furthermore, with the 100 MHz trigger bandwidth, you have a higher trigger sensitivity over the full range.

Extensive Memory Capability

In a DSO, it is vital that the memory be large enough to capture all the data in the intended areas of use. The PM 3335 will be used in automotive, medical, mechanical, video and general electronics industries, as well as in education and training. Here, scopes must capture typical waveforms over a full cycle and have an adequate sample resolution to show fine details within cycle. Typical examples here are in video waveforms or engine injection cycles. With its deep 8 kbytes x 8-bit acquisition memory and 20 MS/s sample rate, the PM 3335 fully meets this requirement — indeed no other instrument in this price class has such a large memory.

For waveform comparison, a second reference memory is available. The full 8 kbytes x 8-bit memory allows storage and display of up to 2 reference waveforms. Together with the 2 live waveforms from the acquisition memory, a total of 4 waveforms can be displayed.

Measurement Cursors as Standard

Independent voltage and time cursors make signal parameter extraction both accurate and fast. Along with measurement of voltage and time differences (dV, dt), the measurement functions include selection of ratio, phase and track. To aid the user further, a simple frequency calculation is made by 1/dt.

Positioning cursors on the easily identified 10% and 90% of peak-to-peak value gives a rise/fall time readout. Cursors are particularly valuable in dc measurements where any point on the captured waveform can be measured to reference ground. This further extends use of the cursors so that readouts can show not only difference results on a single trace, but also from trace to trace.

Powerful Triggering

The PM 3335's deep memory can also be used to show extensive pretrigger information. Unlike a conventional scope, a DSO can pretrigger, i.e. capture and display events prior to a trigger. A DSO continuously acquires data until stopped by detection of a valid trigger signal, rather than starting the sweep on detection of the trigger, like an analog oscilloscope. Thus all samples captured by the DSO are effectively in "negative time" and contain pretrigger waveform information.

This function is very useful in showing, for example, the complete leading edge of a pulse waveform for rise/fall time measurement (compared to an analog scope that can only show the edge form from the trigger moment on). Another example is to examine preshoot signals or transients leading up to the trigger edge. In the PM 3335, up to 20 divisions of pretrigger information can be captured and analyzed.

Two Interfaces in One

The PM 3335 has communication facilities normally only expected in instruments in much higher price ranges. Its optional interface has both RS 232 and GPIB/IEEE-488* capability. Either can control instrument set-up and transfer waveform data in remote control applications. When combined with the increasing range of programming and control packages, the PM 3335 is ideal for automatic signal capture and analysis. In particular, the software package for Oscilloscope Signal Processing (OSP) PM 2260 enables cross-correlations, algebraic manipulations, FFT and many other manipulations on acquired traces.

Mass storage of captured waveforms is also possible via the interfaces. If the large internal memory of 8 kbytes is insufficient, connect the scope to a PC and run the OSP. Simply answer 'yes' to the prompt 'mass storage?' and the software automatically routes all captured data to external storage. Since PM 2260 is a package specifically designed for handling data from scopes, you need not become involved in making the scope communicate with the external storage — that's all done for you by OSP.

Advanced Plot and Print Capability

The PM 3335 has so many functions not usually found in competitive instruments, it should not come as a surprise that it has extensive plot and print capabilities. The plot function outputs screen copies to industry standard plotters and printers via the optional interface card. Plot language is HPGL or Philips GL, covering virtually all available XY plotters. Screen copies can also be sent to EPSON FX 80 printers or compatibles over both interfaces.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 3335

Simple to Operate

While the PM 3335 offers capabilities never before seen in a cost-effective scope, this is not at the expense of ease of use. Ergonomics was a vital element in design of the instrument. All the innovations first introduced on Philips SMART scope range of 60 MHz and 100 MHz analog oscilloscopes are shared by the PM 3335. Innovations such as:

- Direct parameter read-out of the present set-up on an LCD panel for at-a-glance checking of information, avoiding the need to look at control settings on a crowded text plate.
- Fast action up/down controls give finger tip setting of range values quickly and securely. Reliability is guaranteed by cold switching through microprocessor control. All rocker keys are located directly next to the clear LCD for read-out and immediate confirmation of set-up.
- Front panel layout is logical, with similar functions grouped together for instant recognition. All controls that relate to variable settings such as Y-pos or VAR are located on the right hand side of the front panel resulting in a clear layout.
- Softkeys are positioned directly under the CRT display, mounted flush in the screen bezel. Softlabels appear on the screen just above these keys with a readily understandable menu sequence and selection. After acquisition of the signal, attention is focused on the display, avoiding mistakes that can occur when selections are out of the field of vision.

The result is an instrument that is readily understood and easy to use, while offering a versatile capability for fast problem solving.

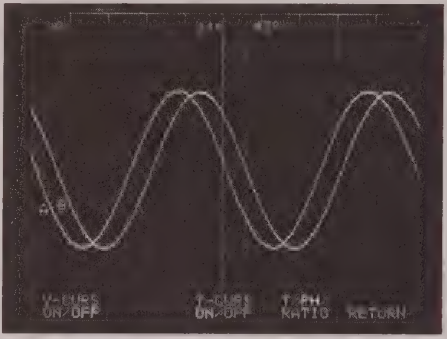
Autoranging, Autoscaling and Autoset

Another first for the PM 3335 is its full function Autoset. A single push of the Autoset button and any signal is automatically scanned and an optimum display of the trace is provided. It is not a factory preset, but is a full autoranging of timebase and amplitude parameters depending on the incoming input signal. In addition, each channel is searched for a signal and if no signals are present, that channel is not displayed to avoid confusing information. Moreover, the Autoset selects the best trigger source for maximum trace stability. No other manufacturer gives you all these facilities for such a low price.

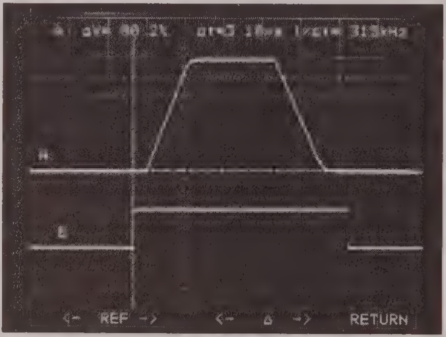
Modular Construction

The PM 3335's modular design and construction gives unparalleled serviceability. Swing up PCB's allow easy access to all circuits, for quick and efficient repair and service. Built in test routines with on screen prompts guide the service engineer quickly to the problem; and a quick check and adjust facility provides verification of the correct functioning of the instrument for reliable measurement results.

The modular construction also allows thorough testing of each module in production, before being built into the complete instrument, after which final functional tests and adjustments are made. This results in reliable instruments that give trouble free operation throughout their life.



Phase measurements between channels are quickly and accurately made thanks to the extensive cursor facilities and the simultaneous acquisition on both channels. Without this simultaneous sampling the timing difference between the channels would result in measurement faults.



Rise times or delay times between channels are simply measured using the 'four way' cursors on the PM 3335.

Specifications

Technical Specifications

Analog Mode

Vertical

Display Modes: YA, YB, -B, A+B, A-B (ALTernate or CHOPped)

Frequency Response:
DC...>50 MHz, -3 dB (20 mV/div...10V/div);
DC...>35 MHz, -3 dB (2 mV/div...10 mV/div);
AC, lower 3 dB point is <10 Hz

Risetime: <7 ns (20mV/div...10V/div);
<10 ns (2 mV/div...10 mV/div)

Deflection Coefficient: 2 mV/div...10V/div in 1, 2, 5 sequence

Error Limit: ±3%, continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting

Input Impedance: 1 MΩ ±2%;20 pF ±2 pF

Maximum Input Voltage: 400V (DC + AC peak)

Dynamic Range: >24 div at 10 MHz, >8 div at 50 MHz

CMRR: 100:1 at 1 MHz

Horizontal

Display Modes: Timebase, or XY displays using YA and/or YB (vertical) and YA, YB or Ext (horizontal)

Timebase: 0.5s/div...50 ns/div in 1, 2, 5 sequence

Expansion: x10, fastest sweep speed 5 ns/div

Error Limit: ±3%; ±4% in x10; continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting

Triggering

Trigger Modes: Auto (free run), non-auto triggered, single sweep

Trigger Sources: A, B, composite (A, B), Ext (DC or AC); line LCD indicates not-triggered, triggered or armed status

Trigger Coupling: Auto peak-to-peak (P-P), DC, TVF, TVL

Trigger Sensitivity:

	Int	Ext
10 MHz	0.5 div	50 mV
50 MHz	1.0 div	150 mV
100 MHz	2.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level range	±8 div	±800 mV

Slope: Positive or negative, TVF or TVL positive or negative

X-Deflection

Deflection Coefficient:
Via Ch A or Ch B, 2 mV/div...10 V/div;
via Ext input, 100 mV/div

Frequency Response: DC to 2 MHz

Error Limit: ±5%

Phase Shift: <3° (at 100 kHz)

Ext Input Impedance: 1 MΩ ±2%;20 pF ±2 pF

Max Input Voltage: 400V (DC + AC peak)

Digital Mode

All specifications as analog part unless otherwise stated

Vertical

Resolution: 8-bit

Display Modes: YA, YB, -B

Frequency Response: DC...>10 MHz, -3dB (2 mV/div...10V/div)

Horizontal

Display Modes: Recurrent, single shot, multiple shot (up to 2)

Timebase

Recurrent, Single, Multiple Shot: 50s/div... 10 µs/div

Timing Accuracy: ±0.1%

Display Expansion: x1...x32

Horizontal Resolution

Single Channel: 8192 samples/channel

Dual Channel: 4096 samples/channel

PM 3335

Signal Acquisition
Maximum Sample Rate: 20 MS/s, simultaneously for both channels
Trigger Delay: 20 divisions of pretrigger

Memory
Storage Registers: 2
Number of Traces Stored in Each Register: up to 2
Depth of Acquisition Memory: 8192 words
Depth of Reference Memory: 8192 words
Vertical Resolution: 8-bit
Display Modes: Ch A, Ch B, Reg A, Reg B in any combination

Cursors
Horizontal Resolution: (all display modes) 1:1000 over 10 divisions
Vertical Resolution: 1:200 over 8 divisions
Read Out Resolution: 3 digits amplitude and time
Calculation Functions: dV, dt, 1/dt, ratio, phase

Interface Option (40)
Contains both IEEE-488 and RS 232C capability

IEEE-488
Bus Driver: E2 (three state)
Function Repertoire: SH1, AH1, T5, L3, SR1, RL2, PP0, DT1, DC1, C0

RS 232C
Handshake: Software XON/XOFF, hardware DSR/DTR and CTS/DTR
Baud Rate: Transmit and receive 75...1200 bits/sec
Stop Bits: 1 or 2
Parity: Odd, even or none
Character Length: 7 or 8 bits

Interface Option (50)

RS 232 C data dump only
Handshake: Software XON/XOFF, Hardware DSR/DRT and CT5/DTR
Baudrate: Transmit 75 ...1200 bits/sec
Stop bits: 1 or 2
Parity: Odd, even or none
Character length: 7 or 8 bits

Digital Plot (Option 40 or 50)

Language: HPGL or Philips GL dependent on plotter type selected
Plotter Select: Philips PM 8153/1*, PM 8153/6*, PM 8154*, PM 8155, HP 7450, HP 7475A
Pen Select:
Pen 1 for Ch A
Pen 2 for Ch B
Pen 3 for Register Ch A
Pen 4 for Register Ch B
Pen 5 for graticule and alphanumerics
Plot Area: Softkey selectable
Dot Matrix Printer Screen Dump: Compatible with Epson FX80 and HP Thinkjet ® graphics protocol or compatibles
Drawing Area: 10 cm x 10 cm

**Not available in North America*

General Specifications

Display

Screen: CRT with 8 x 10 cm viewing area; P31 phosphor, 16 kV acceleration voltage. Softkey display area on CRT for selection of menu choices.
Graticule: Parallax-free with continuously variable illumination.
LCD Display: Separate constantly backlit LCD for display of status information, settings, etc.

Power Supply

Line Voltage Range: 100V...240V AC ±10%
Line Frequencies: 50 Hz...400 Hz ±10%
Power Consumption: 70W

Mechanical Data

Width: 387 mm (15.2 in) incl. handle, 350 mm (13.8 in) excl. handle
Length:
531 mm (20.9 in) incl. handle and knobs
518 mm (20.4 in) incl. handle, excl. knobs
456 mm (17.9 in) excl. handle, incl. knobs
434 mm (17.1 in) excl. handle and knobs
Height: 146.5 mm (5.8 in) incl. feet, 134.5 mm (5.3 in) excl. feet
Weight: Approx 9.5 kg (20.9 lbs) excl. accessries

Environmental Data

Temperature
Rated Range of Use: +10°C...+40°C
Operating Range: 0°C...+50°C
Storage: -40°C...+75°C

Altitude
Operating: 4500 m (15000 ft)
Transport: 12000 m (40000 ft)

EMI: Meets requirements of MIL-STD-461 class B, VDE 6871 and VDE 0875 Grenzwertklasse B
Safety: Meets requirements of IEC 348 class 1, VDE 0411, UL 1244, CSA556 B
Included with Instrument: 2 x PM 8926/09 10:1 probes (with scale factor readout), blue CRT contrast filter, operator manual, power cord.

Ordering Information

Models

January 1989 prices

PM 3335 20 Ms/s, 50 MHz Digital Storage Oscilloscope	$2495
PM 3337 same, with 19 in. Rackmount	2620

Optional Configurations

When ordering, select the basic "PM" model from above, and add the configuration option number listed below as a suffix.

/003 Basic Model	N/C
/403 GPIB IEEE-488/RS 232 Interface installed	add $500

Example, Ordering Configuration
To order the 50 MHz, 20 Ms/s Digital Storage Oscilloscope in rackmountable configuration, with GPIB IEEE-488/RS 232 interface installed, select:

	Model	Price
Basic Oscilloscope	PM 3335	$2495
Configuration Option Suffix	/403	500
Complete Model Number	PM 3335/403	2995

Accessories (See page 53)

Passive Probes	
PM 8922/50 1:1 or 10:1 Probe, cable length 5 ft (1.5m)	$50
PM 8924/00 1:1 Probe, cable length 5 ft. (1.5m)	60
PM 8924/20 1:1 Probe, cable length 8 ft (2.5m)	60
PM 8926/09 10:1 Probe with readout, cable length 5 ft (1.5m)	80
PM 8926/29 10:1 Probe with readout, cable length 8 ft (2.5m)	80
PM 8926/59 10:1 Probe with readout, cable length 4 ft (1.2m)	60
PM 8931/09 20 MΩ 100:1 Probe with readout	135
PM 8936/09 Set of 2 PM 8926/091 Cables	125
Active Probes	
PM 8940/09Q High Voltage Isolation Amplifier with readout	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe with readout	1000
Other Accessories	
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9381 Oscilloscope Camera	650
PM 8991/04 Oscilloscope Cart	450
PM 8992/65 Accessory Pouch	45
PM 8959/001 Retrofittable IEEE-488 (GPIB) and RS 232 Interface	750
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8988 Protective Front Panel Cover	35
PM 2195/09 Probe Switch, 400 MHz	650
PM 2122/01 50Ω Coaxial Switch	680
PM 2230/001 Instrument Drivers Series	590
PM 2240/001 TestTeam Software	925
PM2260/001 Oscilloscope Signal Processing Software	800

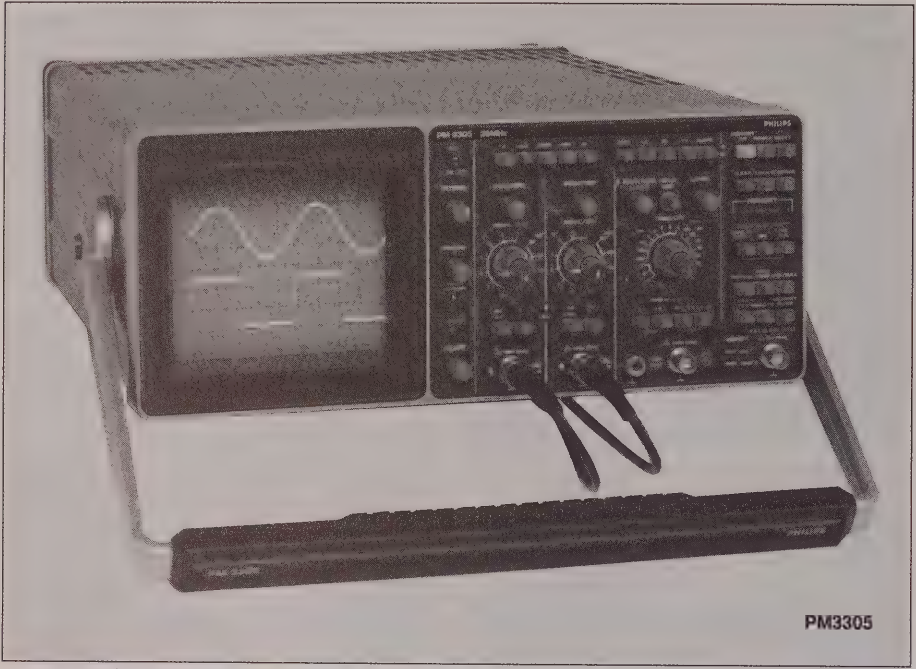
Service and Support

Three-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American requirements. For other power options, see page 491.

PM 3305

GPIB IEEE-488



PM 3305 35 MHz 4-Channel Digital Storage Oscilloscope
4 channels
Memory size: 4096 x 8 bits
Pre-trigger 4096 bits max.
MIN/MAX mode catches 10 ns glitches, displays envelopes
Analog, non-storage operation

The PM 3305 offers digital storage facilities combined with the direct display facilities of a conventional 35 MHz oscilloscope. With its four input channels, PM 3305 becomes an excellent tool for applications, in mechanical and physical environments as well as general electronics.

General Purpose

The oscilloscope offers all well-proven features for ease of operation.

These include excellent trigger facilities such as A/B/Composite/Line/10, combined with a trigger mode such as Auto/DC/AC. Moreover, the oscilloscope can be triggered from extremely complex signals. The 35 MHz vertical bandwidth for both digital display mode and digital storage mode makes the unit a universal and genuinely multipurpose instrument.

Digital Storage

If the MEMORY ON button is pressed the instrument functions as a powerful digital storage oscilloscope, offering an enormous number of measuring possibilities.

4 Channels

In the digital storage-mode, except for the standard A and B inputs, two extra floating channels are available. These extra inputs are especially useful for signals from transducers in mechanical measurements, since the input can be used as a 20 mA/cm or 200 mA/cm current input.

Low Repetition Rate Signals

In the MEMORY ON mode, with the unit functioning as a digital storage oscilloscope, on each trigger, the memory contents are overwritten. A signal with a low repetition frequency is thus displayed with high light intensity.

Link to History

During operation a COMPARE mode can be selected. The live signal is then compared with a signal previously caught in the memory. If the latest signal is better and must be used as a reference it is only necessary to release the button and depress again, and the new signal is frozen as the reference signal.

Single Events

When the SINGLE function is selected, non-repetitive signals can be captured in a time window from 2 ms up to 50 seconds. Depending on the time setting, a resolution of 500 ns can be achieved. This single shot function is combined with RESET a CLEAR function. During waiting time (indicated on a LED) the latest stored signal is visible on the screen.

When the CLEAR button has been depressed the zero reference line is visible on the screen. If the CLEAR button has been depressed twice, the zero line is no longer displayed on the screen.

Peaks and Glitches of ≥10 ns

The disadvantage of digital oscilloscopes has always been the fact the system is not looking at the signal between two sample moments. Glitches and signal peaks shorter than the sampling distance can be missed. The PM 3305 overcomes this problem by means of a built-in MIN/MAX function. In the MIN/MAX mode any pulse pulse longer than 50 ns is stored and consequently displayed at the next moment of sampling. If the pulse is shorter than 50 ns, the amplitude shown might not be representative of the real amplitude, but even a 10 ns pulse is still captured at 55% of its original level.

Modulated Signals

In the MIN/MAX mode, signals with frequency components higher than the sampling rate can be stored and displayed so that the envelope of the modulated signals can be easily made visible.

35 MHz Bandwidth

The digital storage operation does not stop at its maximum sampling frequency. From 0.1 ms/div. to 0.1µs/div., the sampling oscilloscope operates as a sequential sampling system (indicated by LED labelled "Repetitive signals only"). By using this technique, at the full bandwidth of the oscilloscope, the full range of the time base settings can be used as a storage oscilloscope with a minimum equivalent sample distance of 250 ps.

IEEE Bus Operation

The optionally available interface gives access to the digital part of the oscilloscope via GPIB IEEE-488* bus lines. This means that the complete memory or a selected part of it can be transferred to a controller and the same is valid for filling the memories with new data. Time base and all switches related to the digital part of the oscilloscope can be controlled and read by an IEEE-488 bus controller.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Hard Copies

A special version is available if copies on an analog X-Y recorder are required. The IEEE version is supplied with the necessary software to make hard copies on a digital plotter e.g. an HPGL-compatible plotter. Plot size can be switched between 8 x 10 cm and 16 x 20 cm. Moreover, the oscilloscope can be set to the single-shot mode, whereby after catching the signal a hard copy is made and the oscilloscope is ready again for the next single shot. If the plotter has automatic paper transport, a new piece of paper will be provided automatically between recordings. The IEEE version has an alternative analog output as standard.

Many Other Plus Features

Other attractive features of the PM 3305 should not be overlooked. For instance, there is the dual slope triggering, the possibility to expand a selected part of the memory four times, 10 times or even forty times. Other features include the X-Y display facility, the direct output from the A-D converter, the pre- trigger capability of 4096 bits and the possibility of external clock drive, etc.

Specifications

Technical Specifications

CRT

Type: Philips rectangular mesh-type post deflection accelerator tube with 10 kV accelerating voltage and metal backed phosphor
Screen Type: P31 (GH) phosphor standard; P7 (GM) phosphor optional
Useful Screen Area: 8 x 10 cm
Graticule: Internal graticule with centimeter divisions and 2 mm divisions along the central axes. 10% and 90% lines are indicated. Graticule illumination continuously variable.

Vertical or Y-Axis (For A and B channels)

(For C and D channels see DIGITAL STORAGE OPERATION)
Frequency Response: DC: 0 Hz...35 MHz (-3 dB); AC: 2 Hz...35 MHz (-3dB)
Rise Time: 10 ns
Deflection Coefficients: 2 mV/div...10V/div. 1- 2-5 sequence. Uncalibrated, continuous control between steps 1:>2.5
Accuracy: ±3%
Display Modes: Channel A, channel B, alternate, chopped at approx. 500 kHz, added. Channel B can be inverted
Input Impedance: 1 MΩ/20 pF
Maximum Imput Voltage: Undistorted deflection of 24 div. Shift range 16 div.
Signal Delay: ≥2 divisions at 10 ns/div.
CMR-Factor: 100:1 at 1 MHz (A-B mode with 8 div. common mode signal)

Horizontal or X-Axis

Horizontal deflection can be obtained from the main time base, or from an external source. In this case X-Y diagrams can be displayed using Y_A, Y_B, the EXT connector or the mains as signal source for horizontal deflection.
Display Modes: X-Y or X-Y/Y operation with X-deflection by Y_A, Y_B, External or Mains (line)

X-Input

Frequency Response: DC...1 MHz (-3 dB)
Deflection Coefficients: 200 mV/div. using EXT connector; 2V/div. using EXT ÷ 10 connector; Vertical attenuator coefficients apply when Y_A or Y_B is used for X-deflection
Measuring Accuracy: ±10%
Phase Error: 3° at 100 kHz

Time Base

Mode: Automatic or triggered
Time Coefficients: 0.5s/div....100 ns/div. in 1-2-5 sequence (or 5s/div...100 ns/div; see DIGITAL STORAGE OPERATION).
Uncalibrated continuous control between steps 1:>2.5
x 10 magnifier extends max sweep rate to 10 ns/div.
Accuracy: ±3%
Additional error for magnifier ±2%

Triggering

Trigger Source: Internal: Y_A, Y_B, Composite, Line; External; External ÷ 10
Slope: + or - or dual
Trigger Modes: Auto, AC, DC, TV

Trigger Sensitivity:
Internal: 1.0 div. at 35 MHz
Internal: 0.5 div. at 5 MHz
External: 0.2V pp at 35 MHz
External ÷ 10: 2V pp at 35 MHz
TV Int: 0.7 div. sync pulse
TV Ext: 0.15V pp sync pulse
TV Ext ÷ 10: 1.5V pp sync pulse

Trigger Frequency Range:
Auto: 20 Hz...>50 MHz;
AC: 5 Hz...>50 MHz;
DC: 0 Hz...>50 MHz

Trigger Level Range:
Auto: automatically adjusted between limits on signal amplitude.
Internal (AC, DC): 8 div.
External (AC, DC): 1.6V.
External ÷ 10 (AC, DC): 16V
Input Impedance: 1 MΩ//20 pF
Maximum Permissible Input Voltage: 400V (DC + AC peak)
Variable Hold-Off: Sweep hold-off time can be increased by a factor of 10.

Digital Storage Operation

Memory Data
Memory Size: 4096 x 8 bits
Pre-Trigger: 4096 samples max (adjustable in steps of 25%)
Timebase: 0.1 µs/div...5s/div.
Vertical Resolution: 256 steps over 8 cm

Horizontal Resolution:
Single trace 1:4096;
Dual trace 1:2048;
Four trace 1:1024;
Compare + single trace 1:2048;
Compare + dual trace 1:1024;
Compare + four trace 1:512
Max. Sample Frequency: 2 MHz. 1 MHz when external clock is used.

Four-Channel Operation

With the button ABCD CHOP depressed the PM 3305 operates in the four-channel mode. The signal is always captured in the chopped mode.
A and B Channels: As specified for 2-channel operation
C and D Channels: Frequency response DC... 1 MHz (-3 dB)
Deflection Coefficients: 0.1V/div. or 1V/div.
Input: Floating
Vertical Positioning: 10 divisions
Input Impedance: 10 KΩ(DC-coupled)
Max. Input Voltage: 42V (DC + AC peak)
CMRR: 300:1 at 50 kHz

Special Features

Peak Detection: Pulses with pulse width of 50 ns are captured. Pulse of 10 ns is captured at 55% of original level.
Extra Time Coefficients: In the storage mode three extra time base settings are available so that time is expanded to 5s/div.
Compare: 50% of the available memory capacity can be used for storage of a reference signal.

Display Modes

Normal or Smooth Display: Smoothed picture can be made visible.
X=A/Y=B: Signal stored in A is used as reference for horizontal display. Signal stored in B is used as reference for vertical display.
Display Expand: A selected par (1/4 of memory) can be displayed over the screen.

Digital Output

A/D Out: Output from A/D is available on external connector, 8 bits parallel. Conversion ready signal on 9th pin.
Memory Dump: (When equipped with IEEE-bus interface) Memory can be dumped via IEEE connector to external interface. Normal handshake procedure is used.

PM 3305

IEEE Bus Interface (optional): Memory contents, time base and digital oscilloscope settings can be read or be sent.
Analog Output: If the oscilloscope is equipped with an analog output, a copy of the screen can be made on paper via an X-Y recorder (full-scale hor/vert 1V). Pen lift at choice on logical level 0 or 1.
Digital Plot-Out: An option is available for digital plot-out. In combination with the Digital plotter PM 8155 a 1:1 copy of the screen can be made.

General Specification

Calibration

Voltage: 1.2V pp ±1% square wave
Frequency: 2 kHz approx.

Power

Line Voltage and Frequencies: 110, 120, 220 and 240V_{AC} ±10%, 46...440 Hz
DC Power Source: 24...27V_{DC} floating max. 2A
Power Consumption: 70W when powered from nominal line voltage
Insulation: The insulation of the power supply fulfills the safety requirements of IEC 348 CL I for metal encased instruments.
Dimensions and Weight: 337 mm W x 137 mm H x 452 mm L (13.2 in W x 5.4 in H x 17.8 in L) 10 kg (22 lb) (approx.)

Environmental Capabilities

Ambient Temperatures:
Rated range of use +5°C...+40°C;
Operating -10°C...+40°C;
Non-operating -40°C...+70°C
Altitude: Operating: to 5 000m (15 000 ft);
Non-operating: to 15 000m (45 000 ft)
Humidity: 21 days cyclic damp heat 25°C - 40°C, RH 95%
Shock: 30g: half sine wave shock of 11 ms duration: 3 shocks per direction for a total of 18 shocks
Vibration: Vibrations in three directions with a maximum of 15 min. per direction. 5-55 Hz and amplitude of 0.7 mm$_{pp}$ and 3 max. acceleration.
Recovery Time: Operates within 30 minutes coming from -10°C soak, going into 60% relative humidity at +20°C room conditions.
Electromagnetic Interference: Meets VDE 0871 and VDE 0875 Grenzwertklasse B

Interface Functions:

SH1	Source handshake complete capability
AH1	Acceptor handshake complete capability
T5	Capabilities: Basic talker, serial poll, talk only, unaddress if MLA; Output data: settings, data; Status data: Busy/ready data, alarm conditions
L3	Capabilities: Basic listener, listen only, unaddress if MLA; Programming data: Digital settings, memory data
SR1	Complete capability of sending service request
RL2	No local lockout
PP0	No parallel poll
DC1	Complete device-clear capability
DT1	Complete device-clear capability

Included with instrument: 2 Passive 10:1 probes, blue contrast filter, front cover, Operating Manual

Ordering Information

Model

January 1989 prices

PM 3305 Four channel Digital Storage Oscilloscope	$3950

Optional Configurations

When ordering, select basic "PM" Model desired from above, and add the configuration option number listed below as a suffix.

/003 Basic model, bench version	N/C
/403 Same, with GPIB IEEE-488 I/F, includes drivers for digital plotters and analog output for analog XY recorder	add 500
/703 Basic model with analog output for analog XY recorder only	add 275

Example, Ordering Configuration
To order a 35 MHz Digital Storage Oscilloscope with GPIB/IEEE-488 and analog XY recorder output, select:

	Model	Price
Basic Oscilloscope	PM 3305	$3950
Configuration option suffix	/403	500
Complete Model Number	PM 3305/403	4350

Accessories (See page 53)

Passive Probes

PM 8922/501 1:1 or 10:1 Probe, cable length 4 ft. (1.2m)	$50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8926 10:1 Passive Probe, cable length 5 ft (1.5m)	70
PM 8926/20 10:1 Passive Probe, cable length 8 ft (2.5m)	70
PM 8926/501 10:1 Probe, cable length 4 ft (1.2m)	50
PM 8931/00 20 MΩ, 100:1 Passive Probe	125

Active Probes

PM 8940/09Q High voltage Isolation Amplifier	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe	1000

Other Accessories

PM 8901Q Rechargeable Battery Pack	1275
PM 8905 12 Vdc Power Converter	250
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8963/03 Rackmount Adapter	175
PM 8972 Camera adapter for stationary use	85
PM 8991/04 Oscilloscope Cart	450
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9381 Oscilloscope Camera	650
PM 9366 Collapsible Viewing Hood	20

Service & Support

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

Accessories

Compatibility Chart **Use this chart to see which oscilloscope accessories are compatible with the Philips oscilloscopes models listed on the right.**		PM 3308	PM 3340	PM 3295/96A	PM 3285/86A	PM 3264	PM 3050/55/65/70	PM 3052/57/67/72	PM 3266	PM 3219	PM 3305	PM 3320A	PM 3350/65	PM 3335
Passive Probes														
PM 8911/08	low-impedance wide bandwidth probes		•											
PM 8911/09				•	•							•		
PM 8912/08			•											
PM 8912/09				•	•							•		
PM 8922	switchable x1 and x10 probe									•	•			
PM 8922/501	switchable x1 and x10 probe					•	•	•	•	•	•		•	•
PM 8924/00	x1 probes, modular	•		•	•	•	•	•	•	•	•	•	•	•
PM 8924/20		•		•	•	•	•	•	•	•	•	•	•	•
PM 8926	general purpose x10 probes, modular									•	•			
PM 8926/09							•	•					•	•
PM 8926/20									•	•	•			
PM 8926/29		•					•	•					•	•
PM 8928/00						•			•					
PM 8926/501	general purpose x10 probes					•	•	•	•	•	•		•	•
PM 8926/591							•	•					•	•
PM 8929/09	wide bandwidth probes, modular			•	•							•		
PM 8929/19				•								•		
PM 8929/29				•	•							•		
PM 8931/00	high impedance x100 probes					•			•	•	•			
PM 8931/09				•	•		•	•				•	•	•
PM 8933/101	x10 probe	•												
PM 8936/09	set of 2 probes PM 8926/09						•	•					•	•
Active Probes														
PM 8940/09Q	isolation amplifier	•		•	•	•	•	•	•	•	•	•	•	•
PM 8943Q	FET probe	•	•	•	•	•	•	•	•	•	•	•	•	•
PM 9355/09Q	current probe	•	•	•	•	•	•	•	•	•	•	•	•	•
PM 8917/003	Video line selector	•		•	•	•	•	•	•	•	•	•	•	•
Battery Pack														
PM 8901Q						•	•	•	•	•	•		•	•
DC Converter														
PM 8905										•	•			
Accessory Pouches														
PM 8992/xx			/80	/80	/80	/66	/80		/66	/19	/19	/80	/65	/65
Viewing Hoods														
PM 8980	long type					•			•	•	•			
PM 9311/00				•	•									
PM 9310/00	collapsible			•	•									
PM 8981														
PM 9366						•			•	•	•			
Rackmounts														
PM 8960/03						•			•					
PM 8963/03											•			
PM 8964												•		
PM 8965/03										•				
PM 8964/40			•											
PM 8966														
PM 8969							•						•	•
Cart														
PM 8991/04			•	•	•	•	•		•	•	•	•	•	•
Stand														
PM 8999				•	•	•	•	•	•	•		•	•	•

Accessories

		PM 3308	PM 3340	PM 3295/96A	PM 3285/86A	PM 3264	PM 3050/55/65/70	PM 3052/57/67/72	PM 3266	PM 3219	PM 3305	PM 3320A	PM 3350/65	PM 3335
Camera/Adapters														
PM 9381	Camera kit			•	•	•	•	•	•	•	•		•	•
PM 8972	Camera bezel adapter									•	•			
PM 8976	Camera bezel adapter					•			•					
PM 8977/00	Camera bezel adapter			•	•									
Polaroid Anti-Glare Filter														
PM 8910						•			•	•	•			
Adapters/Terminations														
PM 9051		•		•	•	•	•	•	•	•	•	•	•	•
PM 9053				•	•	•	•	•	•	•	•	•	•	•
PM 9061				•	•	•	•	•	•	•	•	•	•	•
PM 9063/001			•											
PM 9067				•	•	•	•	•	•	•	•	•	•	•
PM 9075				•	•	•	•	•	•	•	•	•	•	•
PM 9581/01				•	•	•	•	•	•	•	•	•	•	•
PM 9585/01				•	•	•	•	•	•	•	•	•	•	•
PM 9599/09	Attenuator				•	•						•		
Coaxial Cables														
PM 9071		•	•	•	•	•	•	•	•	•	•	•	•	•
PM 9074		•	•	•	•	•	•	•	•	•	•	•	•	•
IEEE Cables/Adapters/Interfaces														
PM 2295/05	IEEE-488 cable	•	•	•	•		•	•			•		•	•
PM 2295/10	IEEE-488 cable	•	•	•	•		•	•			•		•	•
PM 2295/20	IEEE-488 cable	•	•	•	•		•	•			•		•	•
PM 2296/50	Adapter			•	•		•	•			•		•	•
PM 2296/60	Adapter													
PM 8956/001	IEEE interface													
PM 8956A/001	IEEE/RS 232 interface											•		
PM 8957	IEEE interface												•	
PM 8958	RS-232 interface												•	
PM 8959/001	IEEEInterface/RS-232 Interface													•
PM 8953A/00	IEEE Interface						•	•						
PM 8950/951	IEEE Interface			•	•									
PM 2101/013	Four-way 50Ω coaxial switch		•	•	•							•		
PM 2195/09	High impedance x10 probe switch			•	•		•	•				•	•	•
Miscellaneous														
PM 8994	Accessory set													
PM 8995	wrap adapters (10 p.c.)													
PM 8988	Front cover						•						•	•
PM 8998	Memory back-up						•	•						

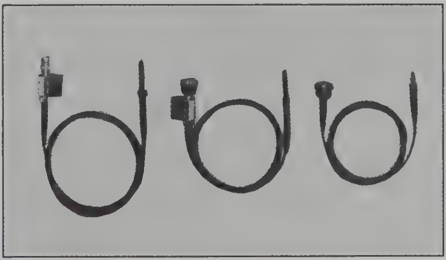
**Oscilloscope model no longer available*

Passive Probe Specifications

Type No.	Attenuation	Useful BW(MHz)	Impedance Ω/pF	Max. Input Voltage (DC + AC PK)	Compensating Range (pF)	Cable Length (M)	Auto Range Indication
PM 8911/08	10x	2000	500//1	15	—	1.5	•
PM 8911/09	10x	1500	500//1	15	—	1.5	•
PM 8912/08	100x	2000	5k//1	50	—	1.5	•
PM 8912/09	100x	1500	5k//1	50	—	1.5	•
PM 8922	1x 10x	10[3] 50	1M//50[1] 10M//15	[2] 600	— 10-60	1.2	
PM 8922/50	1x 10x	6 100	1M//130 10M//14	100 500	— 15-35	1.2	
PM 8924/00	1x	15[3]	1M//47[1]	42	—	1.5	
PM 8924/20	1x	12	1M//74[1]	42	—	2.5	
PM 8926	10x	100	10M//13.5	500	5-40	1.5	
PM 8926/09	10x	100	10M//13.5	500	5-40	1.5	•
PM 8926/20	10x	75	10M//16.5	500	5-40	2.5	
PM 8926/29	10x	75	10M//16.5	500	5-40	2.5	•
PM 8926/50	10x	100	10M//14	500	15-35	1.2	
PM 8926/59	10x	100	10M//14	500	15-35	1.2	•
PM 8928/00	10x	100	10M//13.5	500	5-40	1.5	
PM 8929/09	10x	300	10M//13.5	500	5-20	1.5	•
PM 8929/19	10x	400	10M//12	500	5-20	1	•
PM 8929/29	10x	250	10M//16.5	500	5-20	2.5	•
PM 8931/00	100x	300	20M//2.4	4000	5-30	1.5	
PM 8931/09	100x	300	20M//2.4	4000	5-30	1.5	•
PM 8933/00	10x	50	10M//16.5	500	27-67	1.5	
PM 8933/10	10x	100	1M//35	500	5-40	1.5	•
PM 8936/09 (2x PM 8926/09)	10x	100	10M//13.5	500	5-40	1.5	•

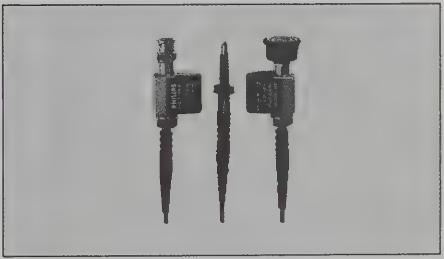
1) Plus input capacity of oscilloscope
2) See maximum input voltage of oscilloscope applied
3) Probe only bandwidth
4) Only with test clip and ground lead

Probe coding for cable length and range indication:
PM 89../XY
Y = 0 no range indication
Y = 9 range indication
X = 0 cable length 1.5m (5 ft)
X = 1 cable length 1m (3.3 ft)
X = 2 cable length 2.5m (8.3 ft)
X = 5 cable length 1.2m (4 ft)
Note: PM 8922 cable length 1.2m (4 ft)



PM 8911/09	$125
PM 8912/09	$125

Wide bandwidth probes for 50Ω inputs

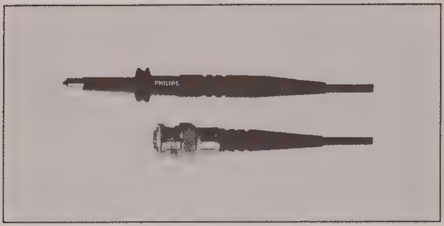


PM 8926	$70
PM 8926/09	$80
PM 8926/20	$70
PM 8926/29	$80
PM 8928/00	$80
PM 8929/09	$90
PM 8929/19	$90
PM 8929/29	$90

General purpose 1:10 probes for frequencies ranging up to 50...400 MHz, depending on type number.

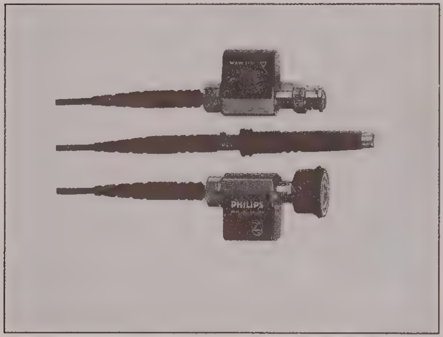
Note: PM 8936/09 is a set of 2 x PM 8926/09.

Accessories



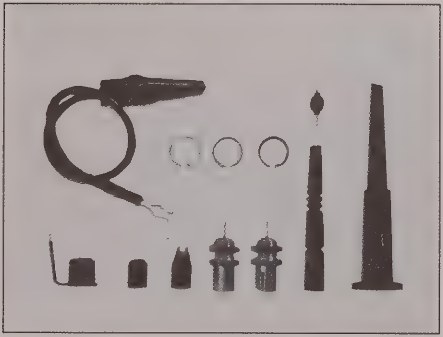
PM 8924/00 $60
PM 8924/20 $60

General purpose 1:1 probe



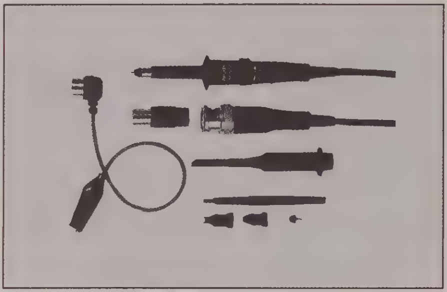
PM 8931/00 $125
PM 8931/09 $135

General purpose 1:100 probes



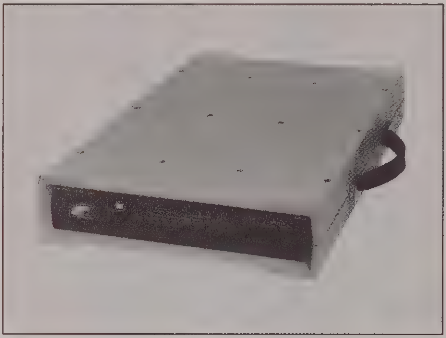
Set of Accessories Supplied with General Purpose Probes

1. Ground lead
2. Mini connector
3. Indication rings
4. Insulating cap
5. Wrap pin adapter
6. Spring loaded test clip
7. Ground needle
8. Measuring tip



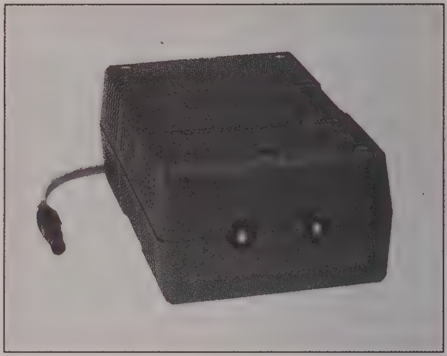
PM 8922 $50

Switchable 1:1, 1:10 probe



PM 8901Q: Battery Pack $1275

Sealed lead-acid batteries provide nominal output voltages of 330 VDC and 24 VDC.
Total Capacity: 180 Wh
Charging Time: 10 hours protected against overload, short circuit and excessive discharge rate.
Dimensions: 32.7 cm W x 7.8 cm H x 50 cm L (12.8 in W x 3 in H x 19.7 in L)
Weight: 9.54 kg (21 lbs) with batteries included.

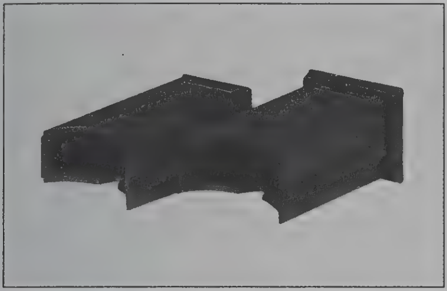


PM 8905: DC-DC Converter $250

12 Vdc to 24 Vdc converter for oscilloscopes with power consumption up to 50W and provided with 24 Vdc power input.
Dimensions: 9.4 cm W x 5.4 cm H x 16.6 cm L (3.7 in W x 2.1 in H x 6.5 in L)
Weight: 0.5 kg (1.1 lbs)

PM 8992: Accessory Pouches $45

PM 8992/19 for PM 3219 and PM 3305
PM 8992/66 for PM 3264 and PM 3266
PM 8992//80 for PM 3050/55, PM 3065/70, PM 3285A/86A, PM 3295A/96A, PM 3320, PM 3340
PM 8992/65 for PM 3335/50/65



PM 8980: Viewing Hood $65
PM 9311/00: Viewing Hood $85

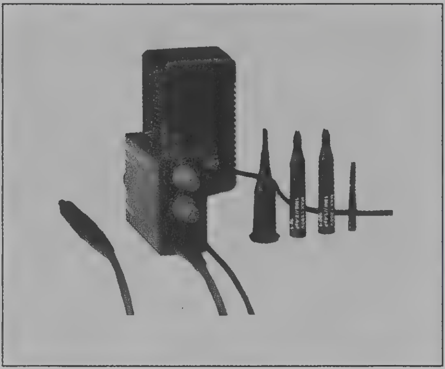
Shielding off of ambient light for better readability of low intensity displays.
PM 8980 for PM 3264, PM 3266, PM 3219, PM 3305
PM 9311/00 for PM 3285A/86A, PM 3295A/96A

PM 8917/003 Video Line Selector $550

Provides trigger pulses to display video waveforms on oscilloscopes

Technical Specifications

System: Accepts both CCIR/EBU (625 line system) and CCIR/FCC (525 line system)
Video Input: 0.5V...3V composite video
Input Impedance: 1 MΩ//30 pF; 75Ω if feed though input is terminated in 75Ω
Max. Non-Destructive Input Voltage: 50V
Output Functions: Frame trigger; field trigger; line trigger; selected line trigger
Output Voltage: 1V in 75Ω
Pulse Width:
Frame Pulse; 0.5x frame width
Field Pulse; 1 µs
Line Pulse; 1 µs
Selected Line Pulse; 64 µs
Powerline Voltage: 90...264V
Powerline Frequency: 44...440 Hz
Power Consumption: 5 VA max.



PM 8943Q FET-Probe $850

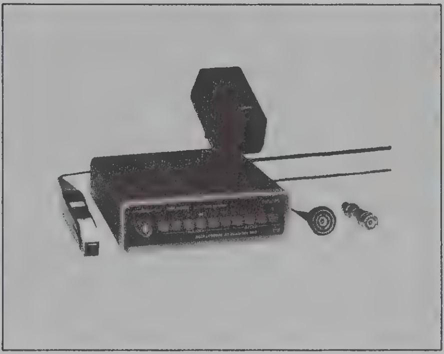
For measurement of low level high frequency signals. The PM 8943 has a very wide frequency response of 650 MHz. An extremely low input capacitance presents minimum loading of the circuit under test. The very wide dynamic range is not limited by the use of any input offset voltage.

Technical Specifications

Frequency Response: DC...650 MHz (-3 dB) (probe output terminated in 50Ω)
Input Attenuators: x1, x10, x100

	x1	x10	x100
Dynamic Range:	+0.6V	+6V	+60V
Input Resistance:	1 MΩ	1 MΩ	1 MΩ
Input Capacitance:	3.5 pF	2.4 pF	1.4 pF
DC Offset Range:	±5V	±50V	±500V

Powerline Voltage: 115V or 220V (-10%...+20%)
Powerline Frequency: 50 Hz...400 Hz (±10%)
Powerline Consumption: 10 VA max.

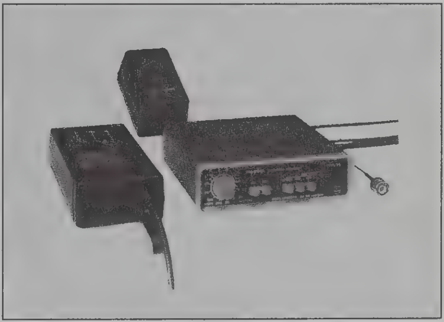


PM 9355/09Q Current Probe $1000

Probe and amplifier combination for displaying and measuring currents in the frequency range of 12 Hz...70 MHz.

Technical Specifications

Deflection Coefficient: 1 mA/div....1 A/div. (oscilloscope set at 20 mV/div.)
Frequency Response:
12 Hz...70 MHz (-3db) at 5 mA/div....1 A/div.;
12 Hz...45 MHz (-3db) at 1 mV/div. and 2 mV/div.
Output Range: +6 or - 6 div. (for f ≥300 Hz)
Powerline Voltage: 115 or 220V (-10%, + 20%)
Powerline Frequency: 50 Hz...400 Hz (±10%)
Powerline Consumption: 10 VA max.

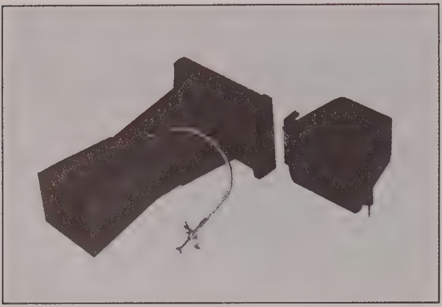


PM 8940/09Q Isolation Amplifier $850

For accurate and safe measurements of small signals floating on high potentials and high frequencies.

Technical Specifications

Frequency Response: DC...1.5 MHz (-3 dB)
Input HI x 10: Max. wire diameter 2 mm
Max. Diff. Input Voltage: 650 Vrms
Diff. Input Impedance: 10 MΩ/9 pF
CMRR: 0.5 div. at CM input voltage of 650 Vrms
Output Dynamic Range: 20 div. at oscilloscope setting of 20 mV/div.
Powerline Voltage: 115V or 220V (-10%...+20%)
Powerline Frequency: 50 Hz...400 Hz (±10%)
Powerline Consumption: 10 VA max.



PM 9381

Polaroid camera for instant oscillograms, usable in hand-held or fixed modes. Kit includes camera, hood and spacer body. Specific oscilloscope adapter required for fixed fitting (see diagram/table).

PM 8991/04

Oscilloscope cart allowing the instrument to be positioned from 15° down to 70° up.
Suitable for all Philips oscilloscopes.

PM 8999

Oscilloscope stand for benchtop or floor standing use, adjustable angle.

PM 2195/09 Probe Switch Unit

The PM 2195/09 Probe Switch is a solution to the problems which can occur when switching waveforms in typical GPIB systems. It consists of a 4-input selector switch and 4 attenuator probes. Each probe can be individually adjusted, to ensure a bandwidth of 400 MHz (3 dB) with an oscilloscope and input capacitance of less than 10 pF. The probe switch compact enough to be plugged directly to the input of an oscilloscope. A maximum of 4 probe switches by a PM 2125 probe switch driver, via the GPIB. For more information see page 383.

PM 2260/001 Oscilloscope Signal Processing Software

PM 2260 Oscilloscope signal processing software is a package for the PC, consisting of software drivers to transfer data from Philips DSOs to the PC, and the ASYSTANT™ software package for waveform analysis, display and storage functions. Processing functions include FFT power spectrum, inverse FFT, differentiation, integration, Blackman window, curve fitting, cross correlation and many more. The entire package is menu-oriented and requires no programming skill. See page 377.

Oscilloscope	Hand-held	Fixed mounting
PM 3050/55/65/70, PM 3335/50/65	8x10 camera, HM/PM 9381	Not possible
PM 3219, PM 3305	8x10 camera, HM/PM 9381	Plus adapter PM 8972
PM 3285A/86A, PM 3295A/96A	8x10 camera, HM/PM 9381	Plus adapter PM 8977/00
PM 3264/66	8x10 camera, HM/PM 9381	Plus adapter PM 8976

1 Camera, **2** Hood, **3** Spacer body, **4** Adapter, **PM 9381** = Camera + hood + spacer body
HM 9381 = Camera only (1); **HM 9382** = Spacer body only (3); **HM 9383** = Hood only (2)

Rackmount Kits

Oscilloscope	Rackmount	Height			Length		Width		Price
		E	mm	in	mm	in	mm	in	
PM 3050/55/65/70	PM 8969	3E	133.35	5.25	392	15.43	482.6	19	$225
PM 3219	PM 8965/03	4E	177.8	7	475	18.70	482.6	19	$175
PM 3264	PM 8960/03	4E	177.8	7	543	21.38	482.6	19	$250
PM 3266	PM 8960/03	4E	177.8	7	543	21.38	482.6	19	$250
PM 3305	PM 8963/03	4E	177.8	7	425	16.73	482.6	19	$175
PM 3320A	PM 8964	4E	177.8	7	variable		482.6	19	$650
PM 3340	PM 8964/401	4E	177.8	7	variable		482.6	19	$650
PM 3335/50/65	PM 8969	3E	133.35	5.25	392	15.43	482.6	19	$225

PM 2240/001 TestTeam $925

PM 2230 Series Instrument Driver Software 590

PM 2240 TestTeam offers a complete, multiple window programming and debugging environment for GPIB application programs. It is easy to use, as the programmer is guided through the package with pull-down windows, pop-up screens and a context sensitive help facility. TestTeam contains instrument, graphics and optional analysis libraries, so programming of GPIB instruments and graphical presentation of data is as easy as filling in a screen panel on the PC.

The debugging facilities of TestTeam include syntax checking, breakpoints, single-step execution and variable tracing and programs can be written in QuickBASIC or C. See page 374.

The PM 2230 Series is a library of are libraries of instrument drivers for most Philips/Fluke GPIB instruments, which make programming of these instruments as simple as setting the instrument via the front panel. All drivers include extensive error checking procedures to guarantee the reliability of test results. Drivers are available in BASICA/GWBASIC, Microsoft Pascal, Microsoft C and QuickBASIC.

PM 8155 Digital Pen Plotter $1750

The PM 8155 full DIN A3 plotter can be linked to any DSO in this catalog to give hard copies. With eight pen colors, individual traces are easily identified. Its large 11 x 17 in./297 x 420 mm chart area can be used for multiple plots. Alternatively, the automatic sheet feeder option can be used for many smaller individual plots. With a 32 kbyte internal buffer data transfer occurs at full speed before plotting is complete. This prevents the oscilloscope from being restricted by the plot speed as with smaller buffers.

Technical Specifications

Interface Type: RS-232 or IEEE-488
Graphics Language: HPGL and Philips GL
Plotting Area: Max. 11.7 x 16.1 in./297 x 410 mm (ANSI-B or ISO A3)
Sheet Feeder: Optional for ANSI-A or ISO A4 sizes for full specs, see page 465.

Bench/System Multimeters

This category of digital multimeters (DMMs) features all the Fluke and Philips bench and system meter line. Included are high speed instruments for use in automated test and measurement systems, and more compact, inexpensive models for less demanding jobs on the workbench or, with battery or battery pack, in the field.

Fluke and Philips bench/system multimeters are available with 3-1/2- to 7-1/2-digits of resolution and a variety of accuracy levels. All system meters are available with either GPIB/IEEE-488 or RS-232 interfaces which allow easy system integration.

See the selection guide on the following page for a comparison of basic specifications and features.

Page 67 PM 2525

Page 61 8842A

Page 72 8506A

Page 85 Fluke 37

Page 95 8920A

Page 87 8050

Selection 60
Bench/System Multimeters 61
Bench/Portable Multimeters 85
RCL Meter 93
RF Voltmeters 95

Bench/System Multimeters

Selection Guide

	Basic Features			Special Features							Interfaces			DC Volts			AC Volts				AC/DC Amp		Ohms, Etc.				
Models	Max Number of Digits	Display	Autoranging	Burst Memory	dB, dBm Readout	Offset/Relative Ref	Touch-Hold	Counter Timer	Capacitance	Temperature	IEEE-488	RS-232-C	Parallel/BCD	Basic 90 Day Accuracy, %	Max Resolution, µV	Max Voltage, w/o Probe	True-RMS	Basic 90 Day Accuracy, %	Max Resolution, µV	Frequency Range, Hz	Max Resolution, nA	Max Amps, w/o Probe	Max Resolution, mΩ*	Max Resistance, MΩ	Diode Test	Conductance (Low) >20 MΩ	Pg
Bench/System Multimeters																											
8840A	5-1/2	VF*	(1)	–	–	•	–	–	–	–	Δ	–	–	0.004	1.0	1000	Δ	0.14	1.0	100k	10k	2.0	1.0	20	–	–	61
8842A	5-1/2	VF*	(1)	–	–	•	–	–	–	–	Δ	–	–	0.0025	0.1	1000	Δ	0.07	1.0	100k	1k	2.0	0.1	20	–	–	61
8840A/AF	5-1/2	VF*	(1)	–	–	•	–	–	–	–	Δ	–	–	0.004	1.0	1000	Δ	0.14	1.0	100k	10k	2.0	1.0	20	–	–	61
PM 2525	5-1/2	LCD	(1)	–	•	•	Δ	•	•	(5)	Δ	Δ	Δ	0.02	1.0	1000	•	0.3	10	100k	0.1	100	10	100	–	–	67
8505A	7-1/2	LED	(1)	–	–	•	–	–	–	–	Δ	Δ	Δ	0.001	0.1	1200	Δ	0.1	1.0	1M	0.1	1.28	0.01	265	–	–	72
8506A	7-1/2	LED	(1)	–	–	•	–	–	–	–	Δ	Δ	Δ	0.001	0.1	1200	•	0.016	1.0	1M	0.1	1.28	0.01	265	–	–	72
8502A	6-1/2	LED	(1)	–	–	•	–	–	–	–	Δ	Δ	Δ	0.001	1.0	1280	Δ	0.1	1.0	1M	1.0	1.28	0.1	262	–	–	99
8520A	5-1/2	LED	(1)	•	Δ	•	–	–	–	–	•	–	–	0.005	1.0	1000	•	0.1	10	1M	–	(3)	0.1	20	–	•	77
8522A	5-1/2	LED	(1)	•	•	•	–	–	–	–	–	–	•	0.005	1.0	1000	•	0.1	10	1M	–	(3)	0.1	20	–	•	77
PM 2534	6-1/2	LCD	(1)	•	–	–	Δ	–	–	–	•	–	–	0.0025	0.1	600	(6)	0.2	10	100k	100	(3)	0.1	300	–	–	81
PM 2535	6-1/2	LCD	(1)	•	•	–	Δ	–	–	–	•	–	–	0.0025	0.1	600	(6)	0.2	10	100k	100	(3)	0.1	300	–	–	81
Bench/Portable Multimeters																											
Fluke 37	3-1/2	LCD	(1)	–	–	•	•	–	–	–	–	–	–	0.1**	100	1000	–	0.5	100	30k	100	10.0	100	32	•	•	85
8050A	4-1/2	LCD	–	–	•	•	(4)	–	–	–	–	–	–	0.03**	10	1000	•	0.5	10	50k	10	2.0	10	20	•	•	87
8010A	3-1/2	LCD	–	–	–	–	(4)	–	–	–	–	–	–	0.1**	100	1000	•	0.5	100	50k	100	10	100	20	•	•	90
8012A	3-1/2	LCD	–	–	–	–	(4)	–	–	–	–	–	–	0.1**	100	1000	•	0.5	100	50k	100	2.0	1.0	20	•	•	90
Wideband True-RMS AC Digital Voltmeters																											
8920A	3-1/2	LED	(1)	–	•	•	–	–	–	–	Δ	–	Δ	(2)	(2)	(2)	•	0.5	1.0	20M	–	(3)	–	–	–	–	95
8921A	3-1/2	LED	(1)	–	•	•	–	–	–	–	Δ	–	Δ	(2)	(2)	(2)	•	0.5	1.0	20M	–	(3)	–	–	–	–	95
8922A	3-1/2	LED	(1)	–	•	•	–	–	–	–	Δ	–	Δ	(2)	(2)	(2)	•	0.5	1.0	20M	–	(3)	–	–	–	–	95
Wideband AC Millivoltmeter																											
PM 2554		Analog	–	–	•	–	–	–	–	–	–	–	–	–	–	–	•	1.5	10	12M	–	–	–	–	–	–	98
Automatic RCL Meter																											
PM 6303	4	LCD	•	–	–	–	–	–	(7)	–	–	–	–	–	–	–	–	–	–	–	–	–	1.0	200	•	•	93

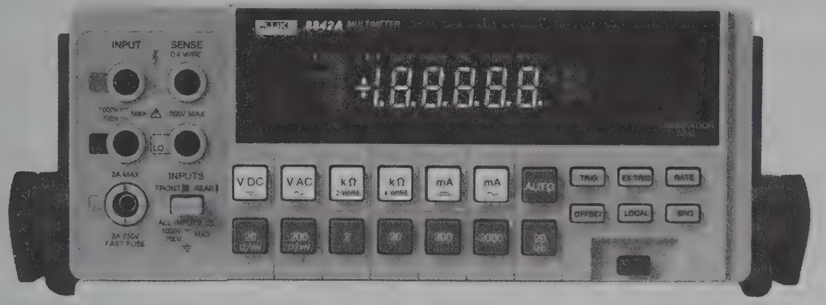
(1) Or Manual ranging
(2) Will measure dc in ac-dc mode
(3) Use 80J-10 or A90 Shunt for up to 10A
(4) Use 80T-H Probe
(5) With PT 100 Probe
(6) AC-coupled RMS
(7) Nine measurement parameters: (D, Q, Rp, Rs, Z, Ls or Lp, Cs or Cp and Cs 2V bias)

• Standard
Δ Optional
** Vacuum fluorescent*
*** 1-year accuracy*

For Handheld Multimeters see page 101.
For Multimeter Accessories see page 127.

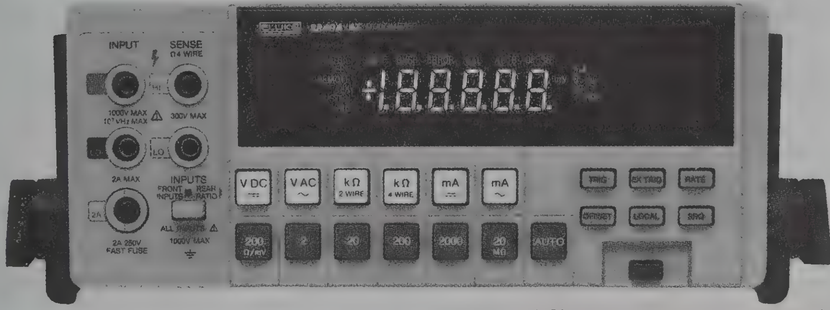
Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

8840 Series



8842A

(NSN 6625--01-217-9427) **8840A**



(NSN 6625-01-196-0014) **8840A/AF**

8840 Series: 5-1/2 Digit Multimeters

- Basic 1-year dc accuracies to 0.003%; ohms accuracy to 0.008%
- Ohms and dc current standard • Ac voltage and current optional (8842A, 8840A)
- Full system capability with optional GPIB/IEEE-488 interface
- Up to 100 readings/second system speed
- Vacuum fluorescent display
- Closed-case calibration • Comprehensive self test

Performance

The 8840 Series has performance you would expect in multimeters costing much more. Basic dc accuracies to 0.003% and basic ac accuracies to 0.08% at one year are available. See the specifications that follow for complete information on measurement ranges and accuracy.

Closed-Case Calibration

No internal adjustments are required for calibration. After you initiate calibration via a recessed front panel switch, you are led through a software controlled procedure that even double checks to ensure that appropriate reference inputs have been applied. Calibration can be performed under front panel or GPIB/IEEE-488* control.

Self Testing

The 8840 Series automatically performs a digital self test each time it is powered up. Additionally, you can initiate a comprehensive analog and digital diagnostic self test from the front panel or through the IEEE-488 interface.

Powerful System Capabilities

Adding the inexpensive IEEE-488 interface option to the 8840 Series provides system capability which includes complete system control of functions, ranges, and reading rates. Front and rear panel inputs are switch-selectable from the front panel (and you can sense the status of the switch over the bus). Calibration and self-test can also be controlled over the bus.

Powerful yet simple device dependent IEEE-488 code allows the 8840 Series DMMs to be easily integrated into your system. System software written for the 8840A is compatible with the 8842A and 8840A/AF.

The mechanical design also contributes to performance and convenience in system applications. The 8840A Series' metal case provides EMI shielding to ensure measurement integrity. The unit can be mounted in a half-rack slot simply by removing the handle, turning the "twist-away" rear feet, and bolting on rackmount brackets.

Embodying all these features, the 8840 Series DMMs are fully programmable, powerful digital multimeters within reach of every system builder.

Technology

A monolithic A/D converter uses CMOS IC designed to achieve the superb accuracy, speed, and reliability of the 8840 Series.

Analog switch ICs developed by Fluke replace discrete switching devices to create superior performance, reliability, and serviceability.

A voltage reference device similar to that found in the Fluke 732A DC Reference Standard provides unmatched stability.

Precision thin film resistor networks establish the accuracy and maintain the stability of the 8840 Series.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

8842A

Now You Can Choose The 8840 Series DMM To Meet Your Performance Needs

8842A: Premium Performance

The 8842A, top of the 8840 line, delivers all the features of the popular 8840A plus new hermetically sealed thin film resistors. These resistors make possible:

- **Increased measurement power:**
  100 nV resolution with a 20 mV range
  1 µA °C resolution with 200 mA range
  100 µΩ resolution with a 20Ω range
- **Enhanced accuracy in V dc, V ac, Ω**
  0.003% basic dc accuracy at 1 year
  0.08% basic ac accuracy at 1 year
  0.006% basic Ω accuracy at 1 year
- **Extended cal cycles, with 2 year specifications**
  0.005% basic dc accuracy at 2 years
- **Two year warranty**

8840A: The Original Value Leader

The original 8840A continues to provide an outstanding combination of low price and high performance. These features, common to all members of the 8840 Series, are responsible for the popularity of the 8840A.

- 0.005% basic dc accuracy at 1 year
- Ease of IEEE-488 system integration
- Closed case calibration
- Extensive self test
- High reliability
- Vacuum fluorescent display
- Fluke's one year warranty applies

8840A/AF: For Tough Assignments

The 8840A/AF delivers all of the 8840A capabilities plus:

- Expanded environmental envelope
- Compliance with MIL-T-28800C Type II, Class 3, Style B
- True rms ac voltage/current capability is standard
- 1000V rms ac maximum allowable input
- Enhanced EMI/RFI protection
- Fluke's one year warranty applies

8842A Specifications

Technical Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5- 1/2 Digits	Resolution 4-1/2* Digits	Input Resistance
20 mV	19.9999 mV	0.1 µV	1 µV	≥10,000 MΩ
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.9999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts)

Range	24 Hour [1] 23±1°C	90 Day 23±5°C	1 Year 23±5°C	2 Year 23±5°C
20 mV [2]	0.0050+20	0.0070+30	0.0100+30	0.0120+40
200 mV [2]	0.0030+2	0.0045+3	0.0070+3	0.0100+4
2V	0.0015+2	0.0025+2	0.0030+2	0.0050+3
20V	0.0015+2	0.0030+2	0.0035+2	0.0060+3
200V	0.0015+2	0.0030+2	0.0035+2	0.0060+3
1000V	0.0020+2	0.0035+2	0.0045+2	0.0070+3

[1] *Relative to calibration standards*

[2] *Within one hour of dc zero, using offset control.*

Medium and Fast Rates: In medium rate, add 2 counts (20 counts on 20 mV range) to number of counts. In fast rate, use two 4-1/2 digit counts (20 counts on 20 mV range) for the number of counts

Operating Characteristics

Temperature Coefficient: >±(0.0006% of Reading + 0.3 Count) per °C fron 18°C to 0°C and 28°C to 50°C

Maximum Input: 1000V dc or peak ac on any range

Noise Rejection: Automatically optimized at power-up for 50, 60 or 400 Hz

Rate	Readings/ Second [1]	Filter	NMRR [2]	Peak NM Signal	CMRR [3]
S	2.5 [5]	Analog & Digital	>98 dB	20V or 2xFS [4]	>140 dB
M	20 [6]	Digital	>45 dB	1xFS	>100 dB
F	100	None	–	1xFS	>60 dB

[1] *Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.*

[2] *Normal Mode Rejection Ratio, at 50 or 60 Hz ± 0.1%. The NMRR for 400 Hz ± 0.1% is 85 dB in S rate and 35 dB in M rate.*

[3] *Common Mode Rejection Ratio at 50 or 60 Hz ± 0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.*

[4] *20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V.*

[5] *Reading rate – .31 rdg/sec. in the 20 mV, 20Ω, 200 mA dc ranges.*

[6] *Reading rate – 1.25 rdg/sec. in the 20mV, 20Ω, 200 mA dc ranges*

True-RMS AC Voltage Option (-09)

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2 Digits	Input Resistance
200mV	199.999 mV	1 µV	10 µV	1 MΩ
2V	1.99999V	10 µV	100 µV	shunted
20V	19.9999V	100 µV	1 mV	by
200V	199.999V	1 mV	10 mV	>100 pF
700V	700.00V	10 mV	100 mV	

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sineware inputs ≥10,000 counts[1] (5% of range)

Freq (Hz)	24 Hour2 23 ±°C	90 Day 23 ±5°C	1 Year 23 ±5°C	2 Year 23 ±5°C
20-45	1.2+100	1.2+100	1.2+100	1.2+100
45-200	0.3+100	0.35+100	0.4+100	0.5+100
200-20k				
(200 mV)	0.06+100	0.08+100	0.10+100	0.20+100
(2-200V)	0.05+80	0.07+80	0.80+80	0.15+80
(700V)	0.06+100	0.08+100	0.10+100	0.20+100
20-50k	0.15+120	0.19+150	0.21+200	0.25+250

[1] *For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz t, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz.*

[2] *Relative to calibration standard.*

Medium and Fast Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥ 1000 4-1/2 digit counts and >100 Hz

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications.

Fundamental Frequency	Crest Factor 1.0 to 1.5	Crest Factor 1.5 to 2.0	Crest Factor 2.0 to 3.0
45 Hz to 20 kHz	0.05	0.15	0.3
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2	0.7	1.5

Operating Characteristics

Maximum Input: 700V rms, 1000V peak or 2 x 10^7 Volts-Hertz product (whichever is less) for any range

Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz 20k-20k	Frequency in Hertz 20k-50k	Frequency in Hertz 50k-100k
≥10,000 counts	0.019+9	0.021+9	0.027+10
≥1,000 counts	0.019+12	0.021+15	0.027+21

Common Mode Rejction: >60 dB at 50 or 60Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution	
		5-1/2 Digits	4-1/2 Digit [1]
200 mA [2]	199.999 mA	1 µA	10 µA
2000 mA	1999.99 mA	10 µA	100 µA

[1] 4-1/2 digits at the fastest reading rate
[2] 200 mA range is dc only

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Range	90 Days 23 ±5°C	1 Year 23 ±5°C	2 Years 23 ±5°C
200 mA	0.04+40	0.05+40	0.08+40
2000 mA			
≤1A	0.04+4	0.05+4	0.08+4
>1A	0.1+4	0.1+4	0.15+4

Medium and Fast Rates: In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4-1/2 digit counts (20 counts on 200 mA range) for number of counts

AC Accuracy: (Requires Option -09)

Normal (S) Reading Rate: ±(% of Reading + Number of Counts) 23° ± 5°C, for sinewave inputs ≥10,000 counts

Time	Frequency in Hertz		
	20-45	45-100	100-5k*
One Year	2.0 + 200	0.5 + 200	0.4 + 200
Two Years	3.0 + 300	0.7 + 300	0.6 + 300

** Typically 20 kHz*

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4-1/2 digit counts and frequencies >100 Hz, the accuracy is ± (0.2 % of reading + 30 counts)

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	Frequency in Hertz		
	1.0 to 1.5	1.5 to 2.0	2.0 to 3.0
45 Hz to 5 kHz	0.05	0.15	0.3
20 Hz to 45 Hz	0.2	0.7	1.5

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C

Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse

Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution		Current Through Unknown
		5-1/2 Digits	4-1/2 [1] Digits	
20Ω[2]	19.9999Ω	0.1 mΩ	1 mΩ	1 mA
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 µA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 µA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 µA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 µA

[1] 4-1/2 digits at the fastest reading rate
[2] 4-wire ohms only

Accuracy

Normal (S) Reading Rate: ± (% of Reading + Number of Counts)[1]

Range	24 Hour[2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C	2 Year 23 ±5°C
20Ω[3]	0.007+30	0.009+40	0.012+40	0.015+40
200Ω	0.0040+3	0.007+4	0.010+4	0.012+4
2 kΩ	0.0025+2	0.005+3	0.008+3	0.010+3
20 kΩ	0.0025+2	0.005+3	0.008+3	0.010+3
200 kΩ	0.0025+2	0.006+3	0.010+3	0.012+3
2000 kΩ	0.023+3	0.025+3	0.027+3	0.030+3
20 MΩ	0.023+3	0.040+4	0.042+4	0.050+4

[1] Within one hour of ohms zero, using offset control
[2] Relative to calibration standards
[3] 4-wire ohms only

Medium and Fast Reading Rates: In medium rate, add 2 counts to the number of counts for the 200Ω through 200 kΩ ranges, 3 counts for the 2000 kΩ and 20 MΩ ranges, and 20 counts for the 20Ω range. In fast reading rate, use three 4-1/2 digit for the number of counts for the 200Ω range, 20 4-1/2 digit counts for the 20Ω range, and two 4-1/2 digit for all other ranges

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

Measurement Configuration: 2-wire or 4-wire (20Ω range is 4-wire only)

Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges

Input Protection: To 300V rms

Reading Rates and Ranging

Reading Rates With Internal Trigger (readings per second):

Rate	Power Line Frequency [1]		
	50 Hz	60 Hz	400 Hz
S	2.08 (.26[2])	2.5 (.31[2])	2.38 (.30[2])
M	16.7 (1.04[2])	20 (1.25[2])	19.0 (1.19[2])
F	100	100	100

[1] Sensed automatically at power-up.
[2] In the 20 mV, 20Ω, and 200 mA ranges. The 8842A does not autorange down into these ranges. To access these ranges, select the specific range, from the front panel or over the bus

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, CT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground

Temperature Range: 0°C to 50°C operating; -40°C to 70°C storage

Humidity Range: 80% RH from 0 to 35°C; 70% to 50°C

Warmup Time: 1 hour to rated specifications

Power: 100, 120, 220, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50, 60, or 400 Hz, automatically sensed at power up; 20 VA maximum

Vibration: Meets requirements of MIL-T-288000C for Type III, Class 3, Style E equipment

Safety: ANSI C39.5 and IEC 348, Class I and VDE 0411 Marks License

Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.5 in x 8.5 in x 14.6 in)

Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)

Warranty Period: Two years

Included: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, instrument performance verificaiton record and serialized and dated calibration sheet

Ordering Information

Models

January 1989 prices

Model	Price
8842A* Basic Digital Multimeter (DC only)	$995
8842A/05 w/IEEE-488 Interface	1145
8842A/09 w/AC Measurement Capability	1245
8842A/059 w/IEEE-488 I/F and AC Measurements	1395

**Option /09 or /059 needed to measure ac*

Options (for 8842A)

Option	Price
-05K* IEEE-488 Interface Kit	170
-09K* True-RMS AC Kit	270

**Required recalibration*

Accessories (Also see page 127)

Accessory	Price
Y8834 Single Rack Mount Kit Offset	65
Y8835 Dual Rack Mount Kit	100
Y8021 1m IEEE-488 Shielded Cable	130
Y8022 2m IEEE-488 Shielded Cable	145
Y8023 4m IEEE-488 Shielded Cable	155
Y8077 Four Terminal Short	35
A90 6-Range Current Shunt	700

8840A Specifications

Technical Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2* Digits	Input Resistance
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.9999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts)

Range	24 Hour[1] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200 mV[2]	0.003+3	0.007+4	0.008+4
2V	0.002+2	0.004+3	0.005+3
20V	0.002+2	0.005+3	0.006+3
200V	0.002+2	0.005+3	0.006+3
1000V	0.003+2	0.005+3	0.007+3

[1] Relative to calibration standards
[2] Using Offset control

Medium and Fast Rates: In medium rate, add 2 counts. In fast rate, use two 4-1/2 digit counts

Operating Characteristics

Temperature Coefficient: >±(0.0006% of Reading + 0.3 Count) per °C from 18°C to 0°C and 28°C to 50°C

Maximum Input: 1000V dc or peak ac on any range

Noise Rejection: Automatically optimized at power-up for 50, 60 or 400 Hz

Rate	Readings/ Second[1]	Filter	NMRR[2]	Peak NM Signal	CMRR[3]
S	2.5	Analog & Digital	>98 dB	20V or 2xFS[4]	>140 dB
M	20	Digital	>45 dB	1xFS	>100 dB
F	100	None	–	1xFS	>60 dB

[1] Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.
[2] Normal Mode Rejection Ratio, at 50 or 60 Hz ± 0.1%. The NMRR for 400 Hz ± 0.1% is 85 dB in S rate and 35 dB in M rate.
[3] Common Mode Rejection Ratio at 50 or 60 Hz ± 0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.
[4] 20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V.

True-RMS AC Voltage Option (-09)

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2* Digits	Input Resistance
200 mV	199.999 mV	1 µV	10 µV	1 MΩ shunted by >100 pF
2V	1.99999V	10 µV	100 µV	
20V	19.9999V	100 µV	1 mV	
200V	199.999V	1 mV	10 mV	
700V	700.00V	10 mV	100 mV	

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sinewave inputs ≥10,000 counts[1] (5% of range)

Range	24 Hour[1] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
20-45	1.2+100	1.2+100	1.2+100
45-200	0.3+100	0.35+100	0.4+100
100-20k	0.07+100	0.14+100	0.16+100
20-50k	0.15+120	0.19+150	0.21+200
50-100k	0.4+300	0.5+300	0.5+400

[1] For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz.
[2] Relative to calibration standards

Medium and Fast Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 4-1/2 digit counts and >100 Hz

Operating Characteristics

Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz 20k-20k	Frequency in Hertz 20k-50k	Frequency in Hertz 50k-100k
≥10,000 counts	0.019 +9	0.021 +9	0.027 +10
≥1,000 counts	0.019 +12	0.021+15	0.027 +21

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency conponents ≤100 kHz, add the following % of reading to the accuracy specifications.

Fundamental Frequency	1.0 to 1.5*	1.5 to 2.0	2.0 to 3.0
45 Hz to 20 kHz	0.05	0.15	0.3
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2	0.7	1.5

**Crest Factor*

Maximum Input: 700V rms, 1000V peak or 2 x 107 Volts-Hertz product (whichever is less) for any range

Common Mode Rejection: >60 dB at 50 or 60Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2 Digit *
2000 mA	1999.99 mA	10 µA	100 µA

**4-1/2 digits at the fastest reading rate*

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Time	90 Days 23 ±5°C	1 Year 23 ±5°C
≤1A	0.04 +4	0.05 +4
>1A	0.1 +4	0.1 +4

Medium and Fast Rates: In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4-1/2 digit counts (20 counts on 200 mA range) for number of counts

AC Accuracy: (Requires Option -09)

Normal (S) Reading Rate: ±(% of Reading + Number of Counts) 23° ±5°C, for sinewave inputs ≥10,000 counts

Time	Frequency in Hertz 20-45	Frequency in Hertz 45-100	Frequency in Hertz 100-5k*
One Year	2.0 +200	0.5 +200	0.4 +200

**Typically 20 kHz*

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4-1/2 digit counts and frequencies >100 Hz, the accuracy is ±(0.2% of reading + 30 counts)

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C

Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse

Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2 * Digits	Current Through Unknown
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 µA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 µA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 µA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 µA

**4-1/2 digits at the fastest reading rate*

8840A & 8840A/AF

Accuracy
Normal (S) Reading Rate: ± (% of Reading + Number of Counts)[1]

Range	24 Hour [2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200Ω	0.004+3	0.011+4	0.014+4
2 kΩ	0.0028+2	0.01+3	0.013+3
20 kΩ	0.0028+2	0.01+3	0.013+3
200 kΩ	0.0028+2	0.01+3	0.013+3
2000 kΩ	0.023+3	0.027+3	0.028+3
20 MΩ	0.023+3	0.043+4	0.044+4

[1] *Using Offset control*
[2] *Relative to calibration standards*

Medium and Fast Reading Rates: In medium rate, add to the number of counts 2 counts for the 200Ω through 200 kΩ ranges and 3 counts for the 2000 kΩ and 20 MΩ ranges. In fast reading rate, use for the number of counts three 4-1/2 digit counts for the 200Ω range and two 4-1/2 digit counts

Operating Characteristics
Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C
Measurement Configuration: 2-wire or 4-wire
Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges
Input Protection: To 300V rms

Reading Rates

Reading Rates With Internal Trigger (readings per second):

Rate	Power Line Frequency*		
	50 Hz	60 Hz	400 Hz
S	2.08	2.5	2.38
M	16.7	20	19.0
F	100	100	100

**Sensed automatically at power-up.*

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground
Temperature Range: 0°C to 50°C operating; -40°C to 70°C storage
Humidity Range: 80% RH from 0 to 35°C; 70% to 50°C
Warmup Time: 1 hour to rated specifications
Power: 100, 120, 220, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50, 60, or 400 Hz, automatically sensed at power up; 20 VA maximum
Vibration: Meets requirements of MIL-T-28800C for Type III, Class 3, Style E equipment
Safety: ANSI C39.5 and IEC 348, Class I and VDE 0411 Marks License
Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.5 in x 8.5 in x 14.6 in)
Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)
Warranty Period: One year
Included: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, instrument performance verification record and serialized/dated calibration certification sheet

Ordering Information

Models

January 1989 prices

8840A* Basic Digital Multimeter (DC only)	$795
8840A/05 w/IEEE-488 Interface	945
8840A/09 w/AC Measurement Capability	990
8840A/059 w/IEEE-488 I/F and AC Measurements	1140

**Option /09 or /059 needed to measure ac*

Options (for 8840A)

-05K* Field Installable IEEE-488 Interface Kit	170
-09K* Field Installable True-RMS AC	205

**Requires recalibration*

Accessories (Also see page 127)

8840A/AF Specifications

Technical Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	4-1/2* Digits	Input Resistance
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.9999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

**4-1/2 digits at the fastest reading rate*

Accuracy
Normal (S) Reading Rates: ±(% of Reading + Number of Counts)

Range	24 Hour [1] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200 mV [2]	0.003+3	0.007+4	0.008+4
2V	0.002+2	0.004+3	0.005+3
20V	0.002+2	0.005+3	0.006+3
200V	0.002+2	0.005+3	0.006+3
1000V	0.003+2	0.005+3	0.007+3

[1] *Relative to calibration standards*
[2] *Using Offset control*

Medium and Fast Rates: In medium rate, add 2 counts. In fast rate, use two 4-1/2 digit counts

Operating Characteristics
Temperature Coefficient: >±(0.0006% of Reading + 0.3 Count) per °C fron 18°C to 0°C and 28°C to 50°C
Maximum Input: 1000V dc or peak ac on any range
Noise Rejection: Automatically optimized at power-up for 50, 60 or 400 Hz

Rate	Readings/ Second [1]	Filter	NMRR [2]	Peak NM Signal	CMRR [3]
S	2.5	Analog & Digital	>98 dB	20V or 2xFS [4]	>140 dB
M	20	Digital	>45 dB	1xFS	>100 dB
F	100	None	–	1xFS	>60 dB

[1] *Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.*
[2] *Normal Mode Rejection Ratio, at 50 or 60 Hz ± 0.1%. The NMRR for 400 Hz ± 0.1% is 85 dB in S rate and 35 dB in M rate.*
[3] *Common Mode Rejection Ratio at 50 or 60 Hz ± 0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.*
[4] *20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V.*

True-RMS AC Voltage

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	4-1/2* Digits	Input Resistance
200 mV	199.999 mV	1 µV	10 µV	1 MΩ shunted by >100 pF
2V	1.99999V	10 µV	100 µV	
20V	19.9999V	100 µV	1 mV	
200V	199.999V	1 mV	10 mV	
700V	700.00V	10 mV	100 mV	

**4-1/2 digits at the fastest reading rate*

Accuracy
Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sinewave inputs ≥5% of range (10,000 counts[1])

Range	24 Hour [1] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
20-45	1.2+100	1.2+100	1.2+100
45-100	0.3+100	0.35+100	0.4+100
100-20k	0.07+100	0.14+100	0.16+100
20-50k	0.15+120	0.19+150	0.21+200
50-100k	0.4+300	0.5+300	0.5+400

[1] *For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz.*
[2] *Relative to calibration standards*

Medium and Fast Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 4-1/2 digit counts and >100 Hz

8840A/AF

Operating Characteristics

Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz		
	20k-20k	20k-50k	50k-100k
≥10,000 counts	0.019+9	0.021+9	0.027+10
≥1,000 counits	0.019+12	0.021+15	0.027+21

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications.

Fundamental Frequency	1.0 to 1.5*	1.5 to 2.0	2.0 to 3.0
45 Hz to 20 kHz	0.05	0.15	0.3
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2	0.7	1.5

**Crest Factor*

Maximum Input: 1000V rms or 2 x 10^7 Volts-Hertz product (whichever is less) for any range

Common Mode Rejection: >60 dB at 50 or 60 Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution	
		5-1/2 Digits	4-1/2 Digit *
2000 mA	1999.99 mA	10 μA	100 μA

**4-1/2 digits at the fastest reading rate*

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Current	90 Days 23±5°C	1 Year 23±5°C
≤1A	0.04+4	0.05+4
>1A	0.1+4	0.1+4

Medium and Fast Rates: In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4-1/2 digit counts (20 counts on 200 mA range) for number of counts

AC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts) 23°±5°C, for sinewave inputs ≥10,000 counts

Time	Frequency in Hertz		
	20-45	45-100	100-5k*
One Year	2.0+200	0.5+200	0.4+200

** Typically 20 kHz*

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4-1/2 digit counts and frequencies >100 Hz, the accuracy is ±(0.2% of reading + 30 counts)

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C

Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse

Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution		Current Through Unknown
		5-1/2 Digits	4-1/2 * Digits	
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 μA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 μA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 μA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 μA

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rate: ± (% of Reading + Number of Counts)[1]

Range	24 Hour [2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200Ω	0.004+3	0.011+4	0.014+4
2 kΩ	0.0028+2	0.01+3	0.013+3
20 kΩ	0.0028+2	0.01+3	0.013+3
200 kΩ	0.0028+2	0.01+3	0.013+3
2000 kΩ	0.023+3	0.027+3	0.028+3
20 MΩ	0.023+3	0.043+4	0.044+4

[1] Using Offset control
[2] Relative to calibration standards

Medium and Fast Reading Rates: In medium rate, add to the number of counts 2 counts for the 200Ω through 200 kΩ ranges and 3 counts for the 2000 kΩ and 20 MΩ ranges. In fast reading rate, use for the number of counts three 4-1/2 digit counts for the 200Ω range and two 4-1/2 digit counts

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

Measurement Configuration: 2-wire or 4-wire

Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges

Input Protection: To 300V rms

Reading Rates

Reading Rates With Internal Trigger (readings per second):

Rate	Power Line Frequency*		
	50 Hz	60 Hz	400 Hz
S	2.08	2.5	2.38
M	16.7	20	19.0
F	100	100	100

[1] Sensed automatically at power-up.

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground

Temperature Range: 0°C to 55°C operating; -62°C to 85°C storage

Humidity Range: 95% RH, +5% to 0%

EMI: Complies with CE01, CE03, CS01, CS02, CS06, and REO2 as specified in MIL-STD-461

Altitude: 4,500m (15,000 ft) operating; 12,000m (40,000 ft) non-operating

Warmup Time: 1 hour to rated specifications

Power: 100, 120, 220, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50, 60, or 400 Hz, automatically sensed at power up; 20 VA maximum

Vibration: Meets requirements of MIL-T-28800C for Type III, Class 3, Style E equipment

Safety: ANSI C39.5 and IEC 348, Class I and VDE 0411 Marks License

Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.47 in x 8.5 in x 14.6 in)

Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)

Warranty Period: One year

Included: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, (with Option -05 only), instrument performance verificaiton record and serialized/dated calibration certification sheet

Ordering Information

Model

January 1989 prices

8840A/AF* Digital Multimeter $1350

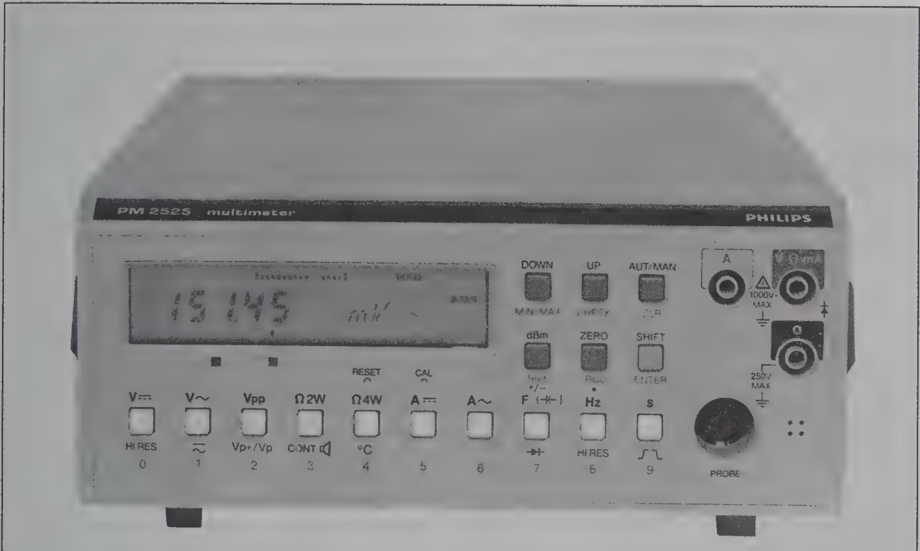
Options (for 8840A/AF)

-05 IEEE-488 Interface 150
-05K Field Installable IEEE-488
Interface Kit 170

PM 2525

GPIB
IEEE-488

RS-232



PM 2525

PM 2525 Digital Multifunctional Multimeter

- 4-1/2 to 5-1/2 digit meter with 0.1 nA resolution (±0.4% ±1.5 digit)
- More measurement functions (Hz, Time, Capacitance, Temp, etc.)
- Battery option for field use
- GPIB/IEEE-488, RS-232C and analog output options for system operation
- Simple command structure for system programming
- Comprehensive overload protection

PM 2525 Measurement Center

The PM 2525 is a very high specification instrument, offering a full range of standard DMM measurement features plus a range of unique extra functions, making it a complete "**measurement center.**"

Besides standard functions such as 8 current, 5 voltage and 7 resistance ranges, the PM 2525 also has the additional features of measurement of frequency, time, temperature, capacitance, dB and continuity.

For precision measurements the PM 2525 includes a 21,000 count facility plus a high resolution mode of 210,000 counts. This gives a resolution down to 1μV for Vdc; 100 pA for ac and dc current; 10 mohm for resistance; and 1 pF for capacitance.

Bench, Battery or System Versions

The PM 2525 is available in five versions covering most applications:

1. **Basic benchtop model:** For use in laboratory, workshop and production environments.
2. **Battery model:** For field use. Rechargeable battery for 5 hrs operation included.
3. **Instrument with an analog output:** For analog registration of the results.
4. **GPIB/IEEE-488* interface version:** For operation with IEEE systems.
5. **RS-232 instrument:** For operation with a computer.

The last two interface versions allow remote control of all instrument settings and downloading of measured values to a computer or system controller. These versions are supplied with special interface software which has the same command structure, in plain English, used by Philips system multimeters. Meters with an interface also have an additional high speed mode which provides 3-1/2 digit Vdc measurements at a rate of approximately 12 measurements/sec.

Current Measurement with Low Voltage Drop

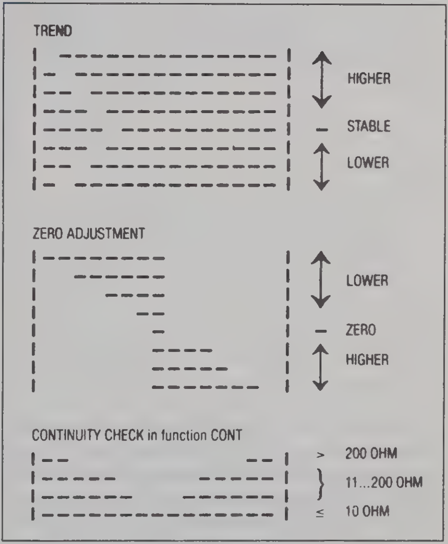
For measurements up to 1 mA the PM 2525 is equipped with a unique current-compensation system that virtually eliminates voltage drops across the meter input, eliminating a common source of significant errors in low current measurements.

More Functions, More Value

	Ranges	Resol.	Accuracy
VDC	5	1 μV	0.02%
VAC	5	10 μV	0.3%
VTrms	5	10 μV	0.3%
Vpeak	4	1 mV	1.0%
IDC	8	100 pA	0.1%
IAC	8	100 pA	0.4%
R (2-wire)	7	10 mΩ	0.1%
R (4-wire)	5	10 MΩ	0.1%
Hz	4	0.1 Hz	0.01%
Capacitance	6	1 pF	1.0%
Time	5	10 μsec	0.01%
Temperature	—	0.1°C	0.3%
Diode	—	100 μV	
dBm	5	0.1 dB	1.0%

Trend Display with an Analog Bargraph

The PM 2525 has an analog bargraph display for optimal presentation of signal trends and precision detection of peak, through or null value, which is particularly valuable for peak tuning of communication equipment, for example. The rotating bargraph indicator on the LCD display steps in proportion to the voltage trend. With a 5V signal, the resolution is 0.01V per step, much higher than can normally be achieved with conventional analog multimeters.



Relative Measurements

Adjustments are easily made by presetting a value as a reference zero by a single touch of the zero-set button. Deviation, positive or negative from the set zero, is then immediately and clearly displayed. Also the bargraph function can be used in the same way so that the bargraph then acts as a very sensitive minus-null-plus indicator.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 2525

Overload Protection

The PM 2525 also includes comprehensive overload protection. All voltage ranges can handle peak transients of up to 2.5 kV without damage, while all other ranges are protected against accidental connection to normal power supplies. The instrument is electronically protected on current ranges up to 1 mA and by a fuse for the 10 mA and 100 mA ranges. The 1A and 10A ranges have a separate input socket.

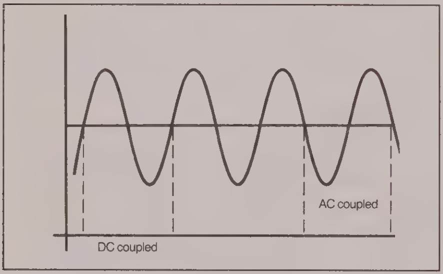
Fast Result with MIN/MAX, Peak-Peak, dBm

A number of special measuring capabilities not only makes measurement easier but allows the user to reach conclusions faster. For practically all measurements the MIN/MAX function can be switched in. This function displays the maximum and minimum reading over a given period, for all measurement functions. Volt peak-peak gives the instant peak voltage. A selection can be made for positive, negative or peak-to-peak values. So, too, can adjustments be made more easily by using the dBm function.

For both current and voltage, the measurement can be read in dBm's. And, since the reference resistance can be easily selected as well, levels can be quickly compared to a known reference.

Choice of AC- or DC-Coupled True RMS Measurements

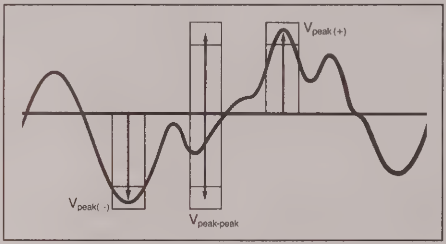
For accurate measurements of AC and AC + DC signal components regardless of the waveform.



True RMS measurements are only possible with DC coupling since the DC component is an important part of the total signal energy. But AC coupling is essential for accurate measurements of AC components on large DC signals. The PM 2525's RMS measurement function always gives accurate RMS readings in both AC- and DC-coupled modes and even with highly distorted signal waveforms.

Accurate Measurement of Peak Values

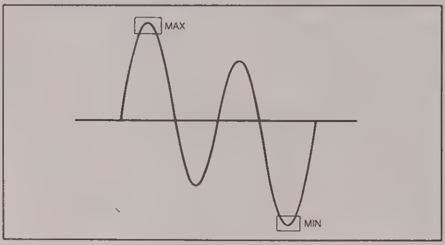
Direct measurement of positive, negative and peak-to-peak values.



This function is valuable for measuring ignition or discharge voltages, as well as for measuring crosstalk between lines, and in electronic circuit design. In combination with Min./Max. mode, the V_{peak} function allows the peak value of disturbances on a signal to be measured over an extended monitoring period.

Convenient Min/Max Measurements

For minimum and maximum values over extended monitoring periods.

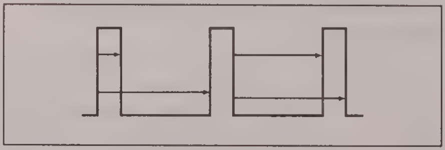


Min./Max. level monitoring throughout the duration of a measurement is easy and convenient with the PM 2525. Measured Min./Max. values are stored until replaced by lower or higher values, and can be recalled and displayed at any time.

This function is useful to measure low-frequency signals (in order of 1 Hz), when the maximum and minimum values can be readout within a few seconds. It also allows highest and lowest temperature values over extended periods to be measured simply and conveniently.

Time and Frequency Measurements

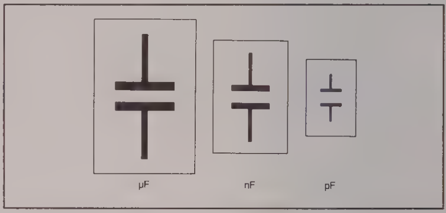
Extra versatility through high-resolutions time and frequency functions.



One of the PM 2525's extra measuring capabilities is a useful time function with a range of up to 100,000s and a maximum resolution of 10 µs. Freely programmable start and stop edges enable all periods and pulse width measurements to be made in a repetitive or single trigger mode. Two different frequency measurements are possible. In the normal mode there is a resolution of 1 Hz, but in the 'High resolution' mode a resolution of 0.1 Hz can be achieved. Maximum frequency is 20 MHz.

Capacitance Measurements

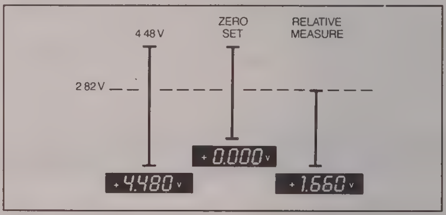
For measuring unknown devices or lead capacitances.



The PM 2525's capacitance function is unmatched in its class. The capacitance of any unknown device, or even of PCB tracks, can be measured directly in a wide range from 20 nF right up to 200 µF, down to a resolution of 1 pF. High noise immunity ensures stable readings at all times, even when using normal DMM test leads, thereby eliminating the need for special guarded leads. Cable capacitance can even be compensated using the zero-set function.

Simple Zero-Setting for Relative Measurements

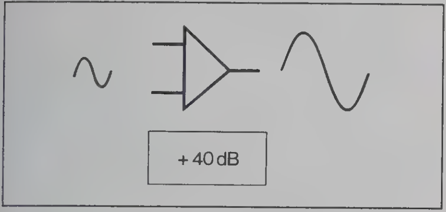
Direct measurement of tolerances or deviations from any preset value.



Zero-setting to use any value for relative reference measurements is done simply with the PM 2525, simply by pressing the ZERO button. This principle allows tolerance measurements, or component deviations from specified values, to be measured directly, and eliminates the need to make all measurements as absolute values.

Direct dB Read-Out

AC and DC voltages shown as dB values to any zero reference level. And with user programmable reference resistance.



This function allows VAC and VDC measurements to be read-out directly as dB values, saving time-consuming calculations. dB measurements are made against an absolute or selectable zero reference level. It is also possible to program a different reference resistance.

Direct dB read-outs are essential for measurements on amplifier gains and losses, or on communications equipment. The dB function can also be used in conjunction with the zero-set mode for 'end-to-end' amplifiers measurements.

Simple Command Structure

The PM 2525 can be used within a system via its IEEE-488 bus interface. In such a system, procedures are programmed using a simple command structure which eliminates complex codes by using straight-forward English statements.

To ease communication with both user and computer, the PM 2525 accepts numeric ranging values in either decimal or exponential notation, and automatically rounds-off to the correct range. To overcome the often lengthy and complex task of splitting the numerical data from the output string, the PM 2525 has an "OUT N" command by which only the numeric value is transferred.

Closed-Case, Electronic Calibration

The PM 2525 can be electronically calibrated and tested without opening the case, if the unit is equipped with an IEEE-488 or RS 232 interface. This function offers substantial time and cost savings and ensures that measurements are always made at optimum accuracy.

Multipoint, Multifunction Measurements

If a system measurement application requires measurements to be made at a number of different points the PM 2525, combined with the Philips System 21 switching system and a IEEE-488 controller, is the cost-effective answer.

This high performance combination can handle any number of single-, dual- or 4-pole measurements at a much lower cost than would be possible with normal large and expensive scanners. Moreover, as it is based around the PM 2525, functions such as frequency, time and peak measurement are also possible, further extending the versatility of remote controlled operation.

Specifications

Technical Specifications

DC Voltage

Range: 200 mV...1000V
Resolution (Norm-mode/HR mode):
10 μV/1 μV
Accuracy: ±0.02% of reading ±0.01% of range
Temperature Coefficient: ±0.003% of reading ±/°C
Input Impedance: ≥10 MΩ//≤90 pF
Offset Current in Input: <20 pA
SMMR (49.95...50.05 Hz): 80 dB
Maximum SM Signal: 2 x range (except 2000V range)
CMRR (For DC and 50 Hz): 120 dB
Maximum CM Voltage: 250V RMS: 350V peak
Response Time
Without ranging: 0.8s; With ranging: 1.5s
Maximum Input Voltage
Hi and Lo: 1000V RMS
Hi and Earth: 1000V RMS
Lo and Earth: 250V RMS
Max. V-Hz Product of Input Signal: 10^7

AC Voltage True RMS (AC or DC Coupled)

Range: 200 mV...1000V
Resolution: 10 μV
Accuracy*
40...100 Hz: ±0.3% of reading ±0.1% of range
0.1...20 KHz: ±1% of reading ±0.1% of range
20...100 KHz: ±5% of reading ±0.5 of range**
Temperature Coefficient: ±0.03% of reading ±0.01% of range/°C
Input Impedance: ≥10 MΩ//≤90 pF
CMRR: For DC: 120 dB; For 50 Hz: 60 dB
Response Time
Without ranging: 1.5s; With ranging: 2s
Crest Factor: 2 at full scale, increasing down scale
Maximum Input Voltage
Hi and Lo: 750V RMS
Hi and Earth: 750V RMS
Lo and Earth: 250V RMS
Maximum V-Hz Product: 10^7

**Additional error for DC-component ±0.2% of reading ±0.1% of range*
***20% in 200 mV range*

DC Current

Ranges: 1 μA...10A
Resolution: 0.1 nA
Number of Counts: Normal mode: 11000
Accuracy: ±0.1% of reading ±0.05% of range
Temperature Coefficient: ±0.01% of reading ±0.005% of range/°C
Voltage Drop Full Scale
1 μA...1 mA: <2.5 mV
10 mA/1A: <40 mV
100 mA/10A: <400 mV
Response Time
Without ranging: 0.8s; With ranging: 2.5s
Protected for 1 μA...100 mA up to: 250V RMS
Max. Input Voltage (common mode): 250V RMS, 350V peak

AC Current True RMS (AC or DC Coupled)

Ranges: 1 μA...10A
Resolution: 0.1 nA on 1 μA range
Number of Counts: Normal mode: 11000
Accuracy (3% - 100% of range): ±0.4% of reading ±0.15% of range
Temperature Coefficient: ±0.04% of reading ±0.015 % of range/°C
Frequency Range: 40 Hz...200 Hz
Voltage Drop
1 μA...1 mA: <2.5 mV
10m and 1A: <40 mV
100 mA and 10A: <400 mV
Crest Factor: 4 at full scale, increasing down scale
Response Time
Without ranging: 1.5s; With ranging: 3s
Protected for 1 μA...100 mA up to: 250V RMS
Max. Input Voltage (common mode):
250V RMS, 350V peak

Ohms

Ranges two-wire: 200Ω..100 MΩ
Ranges four-wire:200Ω...2 MΩ
Maximum Lead Resistance (4 wire): 2Ω
Resolution: 10 mΩ
Number of Counts
200Ω...20 MΩ: 21000; 100 MΩ: 1000
Accuracy
200Ω - 200 KΩ: ±0.1% of rdg ±0.05% of range
2 MΩ - 20 MΩ: ±0.5% of rdg ±0.1% of range
100 MΩ: ±5% of reading ±1% of range
Temperature Coefficient
200Ω- 200 KΩ: ±0.01% of reading ±0.005% of range/°C
2 MΩ - 20 MΩ: ±0.05% of reading ±0.01% of range
100 MΩ: ±0.5% of reading ±1% of range/°C
Measuring Current for each Range: 1 mA, 1 mA, 100 μA, 10 μA, 1 μA, 100 nA, 10 nA
Open Input Voltage: 14V
Response Time (200Ω - 200 KΩ)
Without ranging: 0.8s; With ranging: 2.5s
Response Time (2 MΩ - 20 MΩ)
Without ranging: 2s; With ranging: 3.5s
Response Time (100 MΩ)
Without ranging: 9s; With ranging: 10s
Input Protection: Up to 250V RMS

Peak Voltage

Range: 2V...1000V
Resolution: 1 mV
Number of Representation Units: 2100
Accuracy: ±1% of reading ±1% of range
Temperature Coefficient: ±0.15% of rdg/°C
Input Impedance: ≥10 MΩ//≤90 pF
Measuring Time: 500m sec.

PM 2525

+Continuous Wave Mode:
min pulse width: 5µ sec
min period: 100µ sec for min duration of 500m sec
+Single Shot Mode:
min pulse width: 350m sec
min period: 500m sec synchronized with trigger
Frequency Range (except DC): 20 Hz...200 KHz* Response Time
Peak without ranging: 1 sec.
Peak with ranging: 2.5 sec.
Peak-peak without ranging: 1.5 sec.
Peak-peak with ranging: 5 sec.
Maximum Input Voltage
Hi and Lo: 600V AC or DC or 1000V peak
Hi and Earth: 600V AC or DC
Lo and Earth: 250V AC or DC
Max. V-Hz Product: 10^7
CMMR: DC: 120 dB; MHz: 60 dB

** For 200V range max. 60 Hz*

Frequency

Measurement Range: 1 Hz...20 MHz
Ranges: 10 KHz, 100 kHz, 1 MHz, 10 MHz and 20 MHz
Minimum Frequency: 10 Hz
Resolution (High speed): 1 Hz; High resolution: 0.1 Hz
Number of Counts (10 KHz...10 MHz)
High speed: 10000; High resolution: 100000
Number of Counts (20 MHz)
High speed: 2000; High resolution: 20000
Accuracy: ±0.01% of reading ±2 digits
Temperature Coefficient: ±0.001% of rdg /°C
Response Time (100 KHz...20 MHz)
Without ranging: Normal mode 0.3s
With ranging: Normal mode 0.5s
Without ranging: High resolution 2.5s
With ranging: High resolution 3s
Response Time (10 KHz)
Without ranging: Normal mode 1.5s
With ranging: Normal mode 2s
With ranging: High resolution 13s
Impedance: 10 MΩ//50 pF
Coupling: AC
V-Hz Product for Voltage <5V max.: 10^7
Maximum Input Voltage: 250V
Sensitivity
10 Hz...100 Hz: 1V peak
100 Hz...10 MHz: 250 mV peak
10 MHz...20 MHz: 500 mV peak

Time

Range: 1...105 sec.
Resolution: 10 µsec.
Number of Counts: 99999
Accuracy: 0.01% of reading
Hold-Off Time: 30 µsec.
Start/Stop: Positive or negative slope selectable
Trigger Level: µ0.5V
Modes: Repetitive or single trigger

Capacity

Ranges: 10 nF...2000 µf
Resolution: 1 pF
Number of Counts: 21000
Accuracy: ±1%* of reading ±0.1% of range
Temperature Coefficient: ±0.1%* of reading ±0.01% of range/°C
Measuring Current (for each range): 100 nA, 1 µA, 10 µA, 100µA, 1 mA, 1 mA
Open Input Voltage:≤2.5V
Polarity Input Socket: + on Lo
Response Time (without ranging): 1s
Response Time (with ranging): 1.5s
Protected up to: 250V

** For 2000 µF range 10%*

Continuity

Driving Current: 1 mA
Short circuit: Audible tone from 0...10Ω
Isolation: Resistance <10Ω no tone
Response Time: <0.15s

Diode

Driving Current: 1 mA
Response Time: 0.Ωs
Range: 2000.0 mV
Resolution: 0.1 mV
No. of Counts: 20,000
Max. Input Voltage: 250V

Temperature*

Range:-100°C...+850°C
Resolution: 0.1°C
Number of Counts: 8500
Accuracy (excl. probe): ±0.3% of rdg ±0.3°C
Temperature Coefficient: ±0.03% of reading ±0.003% of range/°C
Measuring Current: 1 mA
Response Time (excl. probe): 0.5s
Linearization: Probe characteristics is linearized within limits stated in DIN 43760

** For temperature additional PM 9249/01 or Pt 100 element is required.*

dB Measurement

dB Reference: 1 mW in reference resistance
Reference Resistor (programmable): 0.0001...9999Ω
Resolution: 0.1 dB
Number of Counts: 8500
Accuracy: ±0.2 dB
Input Impedance: <10 MΩ//<90 pF
CMMR (DC): <120 dB
Response Time: 1.5s

DC Ranges*

Range (600Ω): -77...+62.2 dB
Resolution of Signal <1 mV: 1 dB
Number of Counts if signal <1 mV: 99
Accuracy (if signal <1 mV): ±1 dB
Temperature Coefficient: ±0.0013 dB/°C

AC Ranges*

Range (600Ω): -57.5...+57.5 dB
Accuracy (20 KHz...100 KHz): ±3 dB
Add. Accuracy for DC Component: ±0.2 dB
Temperature Coefficient: ±0.02 dB/°C

** If not specified: see DC VOLTAGE and AC VOLTAGE True RMS.*

Interfaces (Optional)

Three interfaces are available:

(1) The **GPIB** (IEEE-488/IEC-625 compatible) makes it possible to operate in an automatic measurement environment.
Interface Functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1
Programmable: All functions and all ranges

(2) The **RS-232** interface offers a low cost solution for computer control of the interface. The so-called 'Multidrop' mode allows a number of devices to be controlled by the same computer. Selection of the device is made by SOH or STX followed by a selected character.
Interface Functions
Baud Rate: 110...9,600 baud
Stop Bits: 1 or 2
Parity: Odd, even or no
Length: 7 or 8
Input connector: 25 pin male
Handshake: Hardware or software

(3) The **analog output** allows the selective monitoring of a part of the digital display and is scaled between 0 and 1 Volt. A selection can be made which part of the display will be sent to the output.
Output Voltage: 0...1V
Accuracy: ±0.25% of reading ±0.25% of range
Temperature Coeff.: ±0.025% of reading ±0.01% of range
Output Resistance: 200Ω

General Specifications

Power Supply
High Range: 196V...258V, 50 Hz
Low Range: 98V...129V, 60 Hz
Power Consumption: 12 VA
Operating Time (Full Charge): >5 hrs
Charging Time: <15 hours
Temp. Limits of Operation: 0...+45°C
Low Battery Indication: On display

Environmental Conditions

Reference Temperature: +23°C ±1°C
Rated Range of Use: 0°C...+40°C
Operating Range: 0°C...+50°C
Storage and Transport Range: -40°C...+70°C
Humidity Operating Limits: 20...80%
Maximum Dew Point: +26°C
Storage and Transport: 5...95%
Emission: CISPR publ. 11 and 14, VDE 871-B, VDE-875-K acc. to Vfg 1046/84
Safety Class: IEC 348 class II
Calibration Interval: 1 year
Dimensions: 287 L x 210 W x 86 H mm (11.3 in L x 7.3 in W x 3.4 in H)
Weight: 2.5 kg (5.5 lb)

Included With Instrument: 2 measuring leads and probes, Operating manual

Ordering Information

Model

Model	January 1989 prices
PM 2525 Digital Multimeter	$795

Optional Configurations*

When ordering, select the basic "PM" model desired from above and add the configuration option number listed below as a suffix.

/013 Standard Bench Unit	N/C
/213* DMM with built-in battery pack	add 100
/513 DMM with GPIB IEEE-488 Interface*	add 200
/613 DMM with RS-232C Multidrop Interface*	add 200
/713 DMM with analog output	add 200

Accessories (Also see page 127)

PM 2193/01 19-inch Rackmount Kit	$235
PM 9210 HF Probe	259
PM 9213 HF Probe	69
PM 9244 AC/DC Current Shunt	69
PM 9245 AC Current Transformer	65
PM 9246/03 HV Probe	149
PM 9249/01 Pt 100 Temperature Probe (2)	150
PM 9260/00 Pair of Test Leads with Probes	30
PM 9264/01 4-wire Resistance Measurement Cable (1)	85
PM 9266/02 Pair of Safety Test Leads with Probes	39
PM 9267/01 Data Hold Probe (1)	150
PM 9877J/2 Thermocouple Linearizer	200
PM 9877K/2 Thermocouple Linearizer	200

**Factory installable only*

Service & Support

Warranty

One-year product warranty. (See page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see page 491.

8506A & 8505A

GPIB
IEEE-488

RS-232

(NSN 6625-01-234-4134) **8505A & 8506A**

8505A Digital Multimeter

- 5 ppm dc accuracy, 100 nV (nanovolt) sensitivity
- 500 readings per second with 6-1/2 digit resolution
- AC (8505A only), ohms, current module options
- GPIB/IEEE-488, RS-232-C, and parallel interfaces
- Front-rear switchable input standard in basic mainframe
- Software calibration from front panel or remote interface
- Modular construction for application flexibility

8506A Thermal RMS Digital Multimeter

- 8505A features plus
- 120 ppm 24 hour ac accuracy, 40 Hz to 20 kHz
- Full accuracy for crest factors as high as 8:1
- 25 ppm short-term ac stability
- Frequency response specified to 1 MHz
- AC-DC transfer accuracies with DMM speed & convenience

The 8505A and 8506A Digital Multimeters are Fluke's most advanced bench/system DMMs. Both models excel in dc accuracy, resolution, versatility and speed.

The 8506A uses a fast thermal rms sensing technique for measuring ac which very significantly advances the state-of-the-art for ac measurements using a system DMM: It is several times more accurate than the calculating type of true-rms converter and is unmatched by any other DMM. Basic ac accuracy uncertainty is reduced to 120 parts per million 24 hour for frequencies from 40 Hz to 20 kHz. That approximates the accuracy you can expect using traditional thermal transfer techniques that typically take several minutes for each measurement. Short term stability is 25 ppm. Accuracy is specified from 10 Hz to 1 MHz and non-sinusoidal waveforms having crest factors as high as 8 to 1 can be measured with full 90-day accuracy.

Software Calibration

Both the 8506A and 8505A have a "software calibration" feature that makes it easy to store correction factors for every range of any measurement function. You can update the 24-hour accuracy specifications daily, or whenever the need arises without having to remove the covers. Nor do you need to use a cardinal point standard for a reference. Any reference having a suitably accurate value between 60% of range and full scale will do. This "software calibration" is managed with a few keystrokes on the front panel or even remotely when used as part of a test and measurement system.

Measurement Speed

Most system DMM manufacturers use an integrating technique for A-to-D conversion. That means there must be a compromise between resolution and reading speed. The 8505A and 8506A use a Fluke patented "recirculating remainder" technique for A-to-D conversion that does not compromise 6-1/2 digit resolution at reading speeds up to 500 per second for dc voltage measurements. Front or rear measurement inputs are switch-selectable from the front panel. For system applications the position of the switch can be sensed through the interface. An external trigger input is included to control the timing of measurements remotely. And, to control the switching time of an external scanner, scanner-advance output pulses are available at the rear panel.

Either GPIB/IEEE-488*, RS-232-C, or an 8-bit/16-bit parallel interface option may be used for systems applications. The parallel interfaces will work with DEC computer interfaces DR11C or DRV11.

Math Power

The 8506A and 8505A are controlled by an internal microprocessor and have built in math power to add, subtract, multiply, and divide as well as store and compare numerical information. Each measurement may be made a part of a calculation before being displayed or recorded. Stored HI and/or LO limit values may be repeatedly compared to measured values to determine out-of-tolerance conditions, HI, LO, or PASS indications may appear directly in the display. The highest and lowest values in a series of measurements may be stored and later displayed. And measurements may all be in terms of ± deviations from a stored "offset" value. In general, any calculation is possible based on the general formula.

Y = mx+b
Where m = scaling factor (multiplier),
x = value measured,
b = the ± offset, and
Y = the numerical result

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

8506A & 8505A Differences

The 8505A is Fluke's lowest cost DMM having top dc accuracy, resolution, and speed. Two options for measuring ac voltage are available either an ac average-sensing, rms-indicating option (-01) for sinewaves or an ac true-rms option (-09A) for either sinewaves or non-sinusoidal waveforms. An option for measuring current (-03) and an option for measuring resistance (-02A) are also available for the 8505A. For measuring ac current, an ac voltage option (-01 or 09A) must also be installed. An 8505A, when fully equipped, will measure dc and ac voltage, dc and ac current, and resistance.

The 8506A and 8505A have identical dc measurement capabilities but the 8506A requires no option for measuring ac voltage. State-of-the-art ac voltage measurement capabilities are built in. An option for measuring dc current may be installed (-03) or an option for measuring resistance may be installed (-02A), but not both at the same time. Any external dc reference voltage up to 40 volts that is applied at the rear panel may be compared and the relative values displayed as a ratio. The same interface options are available for the 8506A as for the 8505A.

8506A Specifications

Technical Specifications

DC Voltage

All dc voltage accuracy and stability specifications apply after a two-hour warm-up unless otherwise noted. The 24-hour specifications are relative to the calibration standards used.

Input Characteristics

Range	Full Scale 6-1/2 Digits	Resolution		Input Resistance
		7-1/2* Digits	6-1/2 Digits	
100 mV	200.0000 mV	–	100 nV	≥10,000 MΩ
1V	2.000000V	–	1 μV	≥10,000 MΩ
10V	20.00000V	1 μV	10 μV	10,000 MΩ
100V	128.0000V	–	100 μV	10 MΩ
1000V	1200.000V	–	1 mV	10 MΩ

In AVG operating mode

Accuracy, Normal Mode, 6-1/2Digits: ±(% of Rdg + Counts)

Range	24 Hours* 23°C ±1°C	Long Term 18°C to 28°C	
		Up to 90 Days	Add Per Mo Over 90 Days
100 mV	0.0018+15	0.0025+40	0.00017+5.6
1V	0.0008+7	0.0015+8	0.0001+0.1
10V	0.0006 or 6**	0.0010+8	0.0001+0.1
100V	0.0010+6	0.0018+8	0.00013+0.1
1000V	0.0008+6	0.0018+8	0.00013+0.1

** After 4-hour warm-up & within 1 hour of zeroing dc*
***Whichever is greater*

Accuracy, AVG Mode, 6-1/2Digits: ±(% of Rdg + Counts)

Range	24 Hours* 23°C ±1°C	Long Term 18°C to 28°C	
		Up to 90 Days	Add Per Mo Over 90 Days
100 mV	0.0010+8	0.0020+8	0.0001+0.1
1V	0.0005+4	0.0012+6	0.0001+1**
10V	0.0005 or 50***	0.0008+60**	0.00008+1**
100V	0.0005+5	0.0015+6	0.0001+0.1
1000V	0.0005+5	0.0015+6	0.0001+0.1

**After 4-hour warm-up & within 1 hour of zeroing dc*
***7-1/2 digit mode of operation*
**** Whichever is greater*

Accuracy, Software Calibration

Fully restores above "24-hour" accuracy for 24 hours each time performed within 30 days after hardware calibration is performed. After 30 days add the following number of counts to the 24-hour accuracy specifications.

Time Since Internal (Hardware) Calibration	Number of Counts to be Added	
	6-1/2 Digits	7-1/2 Digits
Less than 30 Days	0	0
30 to 90 Days	1	10
90 Days to 1 Year	2	20
More than 1 Year	3	30

Temperature Coefficient: ±(% of Rdg+Counts) /°C

Range	0°C to 18°C and 28°C to 50°C
100 mV	0.0003+5
1V	0.0003+1
10V	0.0002+0.5*
100V	0.0003+1
1000V	0.0003+0.5

** With 6-1/2 digit display. For 7-1/2 digit display, multiply Number of Counts by 10.*

Input Bias Current

At Time of Adjustment	1 Year 23°C ±1°C	Temperature Coefficient
<±5 pA	<±30 pA	<±1 pA/°C

Zero Stability: Less than 5 μV for 90 days after a four-hour warm-up. Front panel pushbutton zero is provided for permanent storage of a zero correction for each range. Zero may be turned off at any time.

Normal Mode Rejection

Line Frequency	Filter Mode	4 Samples Per Reading	32 Samples Per Reading	128 Samples Per Reading
50 Hz	Fast	60 dB	70 dB	75 dB
50 Hz	Slow	85 dB	90 dB	95 dB
60 Hz	Fast	60 dB	70 dB	75 dB
60 Hz	Slow	90 dB	95 dB	100 dB

Common Mode Rejection: 160 dB at 60 Hz with 1 kΩ in series with either lead, and 4 samples or more per reading. Greater than or equal to 100 dB with less than 4 samples per reading.

Analog Settling Time

Filter Mode	Filter Command	To 0.01% of Step Change	To 0.001% of Step Change
Fast	F0 or F3	40 ms	50 ms
Slow	F or F2	400 ms	500 ms

Digitizing Time (Line Synchronous): For 2^0 to 2^{17} samples per reading the digitizing time is from 4 ms to 9 minutes 6 seconds using a 60 Hz line. Time increases 20% using 50 Hz ac line. Selectable in 1Ω binary steps.

Digitizing Time (Line Asynchronous): 2 ms in 3-byte binary mode with dc zero, offset, limits and calibration factors turned off

Maximum Input: ±1200V dc or 1000V rms ac to 60 Hz, or 1400V peak above 60 Hz may be applied continuously to any dc range without permanent damage. Maximum rate of voltage change is 1000V per μs.

Ratio (External DC Reference)

Voltage, resistance, or current may be measured and compared to an external dc voltage and displayed as a ratio. Option -02A or -03 is required when measuring resistance or current. The dc reference voltage (V_{xref}) is applied to terminals on the back panel and is the denominator of the ratio.

Input Resistance: >10,000 MΩ between Ext Ref HI and LO and between either Ext Ref HI or LO and Ohms Guard or Sense LO

Max. Reference Voltage: ±40V between Ext Ref HI and LO terminals providing neither terminal is greater than ±20V relative to the Sense LO or Ohms Guard terminal

Min. Reference Voltage: ≥0.0001V when comparing voltage or current, and ≥0.0001V or 1 billionth of the absolute value of resistance, whichever is greater, when comparing resistance

Maximum Ratio Display: 10^{-9} to 10^{9}

Source Impedance: Resistive unbalance (Ext Ref HI to LO) <4 kΩ. Total resistance to Sense LO from either Ext Ref HI or LO <20 kΩ

Overload Voltage: ±180V dc or peak ac relative to Ohms Guard or Sense LO. ±360V dc or peak ac (Ext Ref HI to LO)

Normal Mode Noise Rejection: ≥100 dB for line frequency and 2x line frequency

Common Mode Noise Rejection: ≥75 dB for dc, line frequency, and 2x line frequency

8506A & 8505A

Ratio Accuracy

External Reference Voltage	Accuracy
±20V to ±40V	±(A + B + 0.001%)
±V_{min} to ±20V	±(A + B + (0.02% |V_{xref}|))

A = 10V dc range accuracy for the appropriate period of time
B = Input signal function and range accuracy for the appropriate period of time
V_{min} = Minimum allowable external reference voltage
|V_{xref}| = Absolute value of the external reference voltage

Digitizing Time: 196 ms to 9 minutes and 6s for 2^0 to 2^{17} samples per reading using 60 Hz line, increasing 20% using 50 Hz line.

AC Voltage (Thermal RMS)

All ac voltage accuracy and stability specifications for 5-1/2 digit displays using at least 25% of full scale after a 2-hour warm-up. Except where noted, ac coupling is used to block dc. The 24-hour specifications are relative to the calibration standards used and within 1 hour of dc zero.

Range	Full Scale 5-1/2 Digits	Resolution		Input Impedance
		6-1/2* Digits	5-1/2 Digits	
100 mV	125.000 mV	–	1µV	1 MΩ ±1% shunted by <180 pF
300 mV	400.000 mV	–	1 µV	
1V	1.25000V	1 µV	10 µV	
3V	4.00000V	1 µV	10 µV	
10V	12.5000V	10 µV	100 µV	
30V	40.0000V	10 µV	100 µV	
100V	125.000V	100 µV	1 mV	
500V	600.000V	100 µV	1 mV	

**In AVG operating mode*

Settling Time

High Accuracy Mode: Sample time is 3.5 seconds, hold time is 2.5 seconds. Measurement time is 6 seconds – the sum of sample time and hold time. If the state of the instrument is unknown, two complete measurement cycles will be required to guarantee a correct reading. Use of an external trigger will allow a 6-second measurement cycle.

Enhanced Mode: The first reading requires the same time as the high accuracy mode. Subsequent readings occur every 500 milliseconds. If the input changes 0.1% the analog settling time to 90-day mid-band accuracy is 1.5 seconds.

Normal Mode: Settling time for large changes is non-linear. Zero to full scale changes require 2.0 seconds to settle to 90-day, mid-band specifications. Full scale to 10% of full scale changes require 3.0 seconds to settle to mid-band, 90-day specifications. Small changes (<1%) settle to mid-band specifications in <1.5 seconds.

Autoranging: Upranges when input is higher than full scale. Downranges when reading is less than approximately 28% of full scale.

Accuracy, High-Accuracy Mode: ±(% of Reading)[1] 24 Hours, 23°C ±1°C[2]

Ranges	Frequency in Hertz						
	10** to 40	40 to 20k	20k to 50k	50k to 100k	100k to 200k	200k to 500k	500k to 1M
100 mV	0.08	0.02*	0.04*	0.2	0.6	1.5	3.5
300 mV to 10V	0.08	0.012	0.04	0.2	0.5	1.5	3.5
30V	0.08	0.012	0.05	0.2	0.5	3.5	12
100V	0.08	0.012	0.04	0.2	1.0	3.5	–
500V[3]	0.08	0.012	0.04	0.2	–	–	–

90 Days, 18°C to 28°C

100 mV	0.08	0.026*	0.06	0.2	0.6	1.5	3.5
300 mV to 10V	0.08	0.016	0.06	0.2	0.5	1.5	3.5
30V	0.08	0.016	0.06	0.2	0.5	3.5	12
100V	0.08	0.016	0.06	0.2	1.0	3.5	–
500V	0.08	0.016	0.06	0.2	–	–	–

>90 Days, 18°C to 28°C, per month. Add to the 90-day specification the following % of reading.

All	0.008	0.001	0.0025	0.012	0.021	0.06	0.11

**Add 5 digits (5 µV) to the % of reading*
***With Slow filter*

Accuracy, Enhanced Mode: Add the following (% of reading + number of digits) to the accuracy specifications of the high accuracy mode –

Ranges	Time Since First Reading	
	<5 Min	>5 and <30 Min
All except 500V	0 + 0	0.003 + 4
500V	0 + 0	0.003 + 6

Accuracy, Normal Mode: Add the following % of reading to the accuracy mode specification of the high accuracy mode –

Segment of Scale	24 Hour 90 Day	<90 Day Add Per Month
0.25 x to 1 x full scale	0.4	0.044
0.1 x to 0.25 x full scale	0.6	0.055

DC-Coupled (AC+DC) Accuracy: ±(1.1 times the appropriate ac-coupled specifications + a calculated "Adder" from the following table)

Range	Adder
100 mV-1V	±(150 µV x (dc volts/total rms volts))
3V & 10V	±(1 mV x (dc volts/total rms volts))
30V & 100V	±(10 mV x (dc volts/total rms volts))
500V	±(50 mV x (dc volts/total rms volts))

Stability: 40 Hz to 20 kHz, <1°C Temperature Change

Range	±(% of Rdg + Counts)*	
	24 Hours	90 Days
100 mV, 1V, 10V, 100V	0.0025 + 1	0.004 + 1
300 mV, 3V, 30V	0.0025 + 3	0.004 + 4
500V	0.0025 + 5	0.004 + 6

**For 5-1/2 digit resolution*

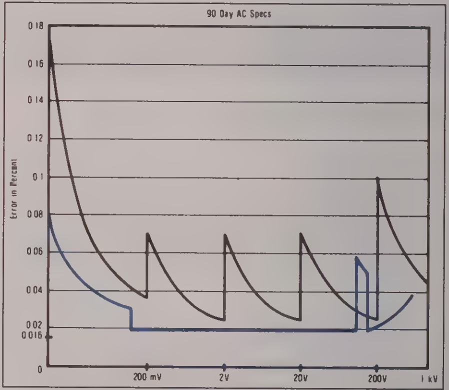
Crest Factor: Up to 8:1, with 90-day or greater accuracy for input signals with peaks less than two times full scale and high frequency components within the 3 dB bandwidth. Up to 4:1 for signals with peaks less than four times full scale, with the addition of 0.03 to the percent-of-reading specification.

3 dB Bandwidth (Typical): 3 MHz for the 100 mV range and 10 MHz for the 300 mV, 1V, 3V and 10V ranges

Maximum Input Voltage: ±600V dc or rms ac, 840V peak, or 1×10^7 volt-hertz product

Temperature Coefficient: One tenth of the 90-day accuracy specification per °C from 18°C to 0°C or 28°C to 50°C

Common Mode Rejection: >120 dB from dc to 60 Hz with 100Ω in series with either lead



This graph compares the total ac uncertainty of the 8506A's thermal rms converter to that of a typical computing rms converter used in other DMMs. The effects of floor error which cause large uncertainties at the beginning of each range are non-existent in the 8506A from 125 mV ac to 125V ac.

Notes:

[1] AC coupled, 5-1/2 digits, input level >0.25 x full scale. For 6-1/2 digits multiply Number of Counts by 10. For input levels between 0.1 x and 0.25 x full scale, add 5 counts for the 100 mV, 1V, 10V, and 100V ranges, add 15 counts for the 300 mV, 3V, 30V ranges, and add 25 counts for the 500V range.

[2] Relative to calibration standards, within 1 hour of dc zero.

[3] Add 0.02 x (Input voltage/600)^2 % of Reading to the specification.

8506A Option Specifications

Resistance Option (-02A)

All resistance accuracy and stability specifications apply after a 2-hour warm-up. The 24-hour specifications are relative to the calibration standards used.

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution*		Current Through Unknown
		6-1/2* Digits	5-1/2 Digits	
10Ω	20.0000Ω	10 µΩ	100 µΩ	10 mA
100Ω	200.0000Ω	100 µΩ	6-1/2 Digits Only	10 mA
1kΩ	2.000000kΩ	1 mΩ		1 mA
10kΩ	25.0000 kΩ	10 mΩ		78 µA
100 kΩ	250.000 kΩ	100 mΩ		7.2 µA
1 MΩ	4.10000 MΩ	1Ω	10Ω	4.5 µA
10 MΩ	35.0000 MΩ	10Ω	100Ω	0.45 µA
100 MΩ	265.000 MΩ	100Ω	1 kΩ	56 nA

** In normal operating mode, 5-1/2 or 6-1/2 digits depending on range. In AVG operating mode, 6-1/2 digits on all ranges.*

Open Circuit Voltage: 7V maximum from 10Ω through 100k range; 25V maximum from 1 MΩ range through 100 MΩ range
Maximum Input: ±400V dc or peak ac, continuous on any range with no damage
Analog Settling Time: 80 ms with Fast filter or 800 ms with Slow filter, to rated accuracy
Digitizing Time: Depending on sample rate and filter selection the digitizing time will vary from 145 ms to 9 minutes 6 seconds using a 60 Hz ac line. Time increases 20% using a 50 Hz line.

Accuracy, 5-1/2Digits: ±(% of Rdg + Counts)**

Range	24 Hours 23°C ±1°C	Long Term 18°C-28°C		Plus Temp Coefficient Per °C*
		Up to 90 Days	>90 Day, Add to % of Rdg Per Month	
10Ω	0.003+20	0.005+20	0.00056	0.0008+15
100Ω	0.002+1.4	0.003+1.4	0.00033	0.0007+0.2
1 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.2
10 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.2
100 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.5
1 MΩ	0.002+0.8	0.003+0.8	0.00033	0.001+0.5
10 MΩ	0.0075+0.8	0.02+0.8	0.0022	0.005+0.5
100 MΩ	0.026+0.8	0.05+1	0.0056	0.02+0.5

**From 18°C to 0°C or 28°C to 50°C*
***For 6-1/2digit display, multiply number of counts by 10*

Measurement Configuration: Two-wire and four-wire available on all ranges
Four-Wire Lead Resistance: Source leads should not exceed 10Ω for the 10Ω and 100Ω ranges, 100Ω for the 1 kΩ range, or 1 kΩ for the 10 kΩ or higher ranges

DC Current Option (-03)

All current accuracy and stability specifications apply after a 2-hour warm-up. The 24-hour specifications are relative to the calibration standards used. No ac current option is available for the 8506A.

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution		Voltage Burden
		6-1/2* Digits	5-1/2 Digits	
100 µA	250.0000 µA	0.1 nA	1 nA	≤100 mV
1 mA	2.00000 mA	1 nA	10 nA	≤100 mV
10 mA	16.0000 mA	10 nA	100 nA	≤200 mV
100 mA	128.000 mA	100 nA	1 µA	≤200 mV
1A	1.28000A	1 µA	10 µA	≤500 mV

** In AVG operating mode 100µA ac range is 5-1/2 digits only*

Accuracy, 5-1/2 Digits: ±(% of Rdg + Counts)**

Range	24 Hours 23°C ±1°C	Long Term 18°C-28°C		Plus Temp Coefficient Per °C*
		Up to 90 Days	>90 Day, Add to % of Rdg Per Month	
100 µA	0.02+10	0.03+10	0.0022	0.0025+0.6
1 mA	0.02+10	0.03+10	0.0022	0.0025+0.6
10 mA	0.02+10	0.03+10	0.0022	0.0025+0.6
100 mA	0.03+20	0.05+20	0.0056	0.0035+0.6
1A	0.03+20	0.05+20	0.0056	0.0035+0.6

**From 18°C to 0°C or 28°C to 50°C*
***For 6-1/2 digit display, multiply number of counts by 10*

Overload: 1.5A maximum, ±140V dc or peak ac to 60 Hz, or 200V peak ac above 60 Hz on any range with no damage. Protected by a 1.5A fuse.
Settling and Digitizing Time: Same as for dc volts

IEEE-488 Interface Option (-05)

This interface incorporates the following subset of the IEEE Standard 488-1978; SH1, AH1, T5, L4, SR1, RL2, DC1, DT1, and E1. The interface allows full control of all instrument functions and the transfer of ASCII or binary data. In the binary mode the instrument is capable of 500 readings per second.

RS-232 Interface Option (-06)

This interface is a bit serial asynchronous interface providing either voltage or 20 mA current loop level signals. The interface allows selection of baud rate from 50 to 9600, either one or two stop bits, and odd or even parity. Up to 40 ASCII character readings per second are possible with Option -06. No handshakes are provided.

Bit-Parallel Interface Option (-07A)

Permits you to connect the instrument to a DEC PDP11 minicomputer interfaces (DR11C and DRV11). The interface permits either 8- or 16-bit parallel ASCII transfers or 8- or 16-bit parallel binary transfers. In the binary mode the instrument is capable of up to 500 readings per second

8505A Specifications

Technical Specifications

DC Voltage

Same specifications as for 8506A

Ratio (External DC Reference)

Same specifications as for 8506A for dc ratio. AC/AC ratio available upon special request

8505A Option Specifications

Input Characteristics (-09A and -01)

Range	Full Scale 5-1/2 Digits	Resolution		Input Impedance
		6-1/2* Digits	5-1/2 Digits	
1V	2.50000V	1 µV	10 µV	MΩ shunted by <100 pF
10V	20.0000V	10 µV	100 µV	
100V	160.000V	100 µV	1 mV	
100V	1000.00V	1 mV	10 mV	

** In AVG operating mode*

True-RMS AC Voltage Option (-09A)

All true-rms ac voltage accuracy and stability specifications apply to readings between 0.1% of range to full scale after a 2-hour warm-up. Options -09A and -01 may not be installed at the same time.

Accuracy: ±(% of Rdg + % of Full Scale)*

Frequency	90 Days, 19°C to 28°C		
	% of Input	+ % FS (AC)	+ % FS (AC + DC)
DC	0.1	–	0.03
10 Hz-20 Hz	1.0	0.04	0.06
20 Hz-50 Hz	0.5	0.012	0.03
50 Hz-10 kHz	0.1	0.012	0.03
10 kHz-30 kHz	0.2	0.04	0.06
30 kHz-50 kHz	0.3	0.1	0.12
50 kHz-100 kHz	1.0	0.3	0.3
100 kHz-300 kHz	2.0	0.5	0.5
300 kHz-1 MHz	3.3	1.8	1.8

**Slow filter must be used below 400 Hz. For inputs greater than 500V multiply the accuracy specification by: (200 + reading) ÷ 2000*

Common Mode Rejection: >120 dB, dc to 60 Hz, with 100Ω unbalance in either lead
Crest Factor: >7 at full scale, increasing down scale by

$$7 \times \sqrt{V_{Range} \div V_{Reading}}$$

Voltage & Frequency Limits: $1\text{x}10^7$ volt-hertz product for the 1V and 10V ranges and $2\text{x}10^7$ for the 100V and 1000V ranges
Analog Settling Time: 100 ms with Fast filter and 500 ms with Slow filter to within 0.1% of a step change within a range
Digitizing Time: Same as for dc voltage. See 8506A specifications

8506A & 8505A

Averaging-Sensing AC Voltage Option (-01)

All average-sensing ac voltage accuracy and stability specifications apply to a 5-1/2 digit display with readings between 0.1% of range to full scale after a 2-hour warm-up. Option -01 and -09A may not be installed at the same time.

Accuracy: ±(% of Rdg + Counts)*

Frequency	90 Days, 18°C to 28°C	
	1 mV to 500V**	Above 500V
30 to 50 Hz	0.5 + 5	0.55 + 5
50 Hz to 10 kHz	0.05 + 5	0.1 + 5
10 to 40 kHz	–	0.15 + 5
10 to 50 kHz**	0.1 + 5	–
50 to 100 kHz**	0.5 + 5	–

**Slow filter must be used below 400 Hz. For 6-1/2 digit display, multiply number of counts by 10*

***On 1-volt range add 7 counts above 10 kHz or 35 counts above 50 kHz*

Common Mode Rejection: >120 dB, dc to 60 Hz with 100Ω inbalance in either lead

Voltage & Frequency Limits: 1000V rms (1400V peak) or 2x10^7 volt-hertz product, whichever is less

Analog Settling Time: 100 ms with Fast filter and 500 ms with Slow filter to within 0.05% of a step change within a range

Digitizing Time: Same as for dc voltage. See 8506A specifications

Resistance Option (-02A)

Same specifications as for 8506A

DC and AC Current Option (-03)

All accuracy and stability specifications apply after a 2-hour warm-up

Input Characteristics: Same as for 8506A

DC Current Accuracy: Same as for 8506A

AC Current Accuracy, 8505A only: ±(% of Rdg + Counts)*

Range	Frequency	90 Days, 23°C ±5°C	
		Opt -01	Opt -09A
100 µA	10 Hz - 20 Hz	–	1.0 + 110
	20 Hz - 50 Hz	0.8 + 9	0.8 + 35
	50 Hz - 10 kHz	0.4 + 9	0.4 + 35
	10 kHz - 20 kHz	0.7 + 9	1.0 + 110
	20 kHz - 50 kHz	1.5 + 9	1.5 + 260
	50 kHz - 100 kHz	3.0 + 9	4.0 + 760
1 mA and 10 mA	10 Hz - 20 Hz	–	1.0 + 110
	20 Hz - 50 Hz	0.5 + 9	0.5 + 35
	50 Hz - 10 kHz	0.06 + 9	0.11 + 35
	10 kHz - 20 kHz	0.11 + 9	0.2 + 110
	20 kHz - 50 kHz	0.12 + 9	0.3 + 260
	50 kHz - 100 kHz	0.51 + 9	1.0 + 760
100 mA	10 Hz - 20 Hz	–	1.0 + 150
	20 Hz - 50 Hz	0.5 + 55	0.5 + 80
	50 Hz - 10 kHz	–	0.26 + 80
	50 Hz - 100 kHz	0.24 + 55	–
1A	10 Hz - 20 Hz	–	1.0 + 160
	20 Hz - 50 kHz	0.5 + 65	0.5 + 90
	50 Hz - 10 kHz	0.24 + 65	0.26 + 90

** With 5-1/2 digit display. For 6-1/2 digit display, multiply number of counts by 10. AC Voltage Option -01 or -09A must also be installed to measure ac current*

Crest Factor: (Using Option -09A) >4.5 at full scale, increasing down scale by

$$4.5 \times \sqrt{I_{Range} - I_{Reading}}$$

Maximum Overload: 1.5A maximum, ±140V dc or peak ac to 60 Hz, or 200V peak ac above 60 Hz on any range with no damage. Protected by a 1.5 fuse

Settling and Digitizing Time: Same as dc volts

IEEE-488 Interface Option (-05)

Same specifications as for 8506A

RS-232 Interface Option (-06)

Same specifications as for 8506A

Bit-Parallel Interface Option (-07A)

Same specifications as for 8506A

General Specifications

Maximum Terminal Voltage:
LO to Guard, 127V rms
Guard to Chassis, 500V rms
HI Sense to HI Source, 127V rms
LO Sense to LO Source, 127V rms
HI Sense to LO Sense, 1000V rms or 1200V dc
HI Source to LO Source, 280V rms

Trigger Input: TTL level, ±30V maximum, factory wired for falling edge; may be rewired for rising edge. Pulse width ≥10 µs

Scanner Advance Pulse: TTL level, ≥3 µs width

Shock & Vibration: Meets requirements of MIL-T-28800C for Type III, Class 5, Style E equipment

Temperature: 0°C to 50°C, operating; -40°C to 70°C, non-operating

Relative Humidity: ≤80% to 18°C, ≤75% to 40°C, ≤45% to 50°C

Size: 10.8 cm H x 43.2 cm W x 42.5 cm D (4.25 in x 17 in x 16.75 in)

Weight: 10 kg (22 lb) basic, 12 kg (26 lb) fully loaded

Power: 100, 120, 220 or 240 volt, 47-63 Hz, switch selectable

Included: Manual, power cord, serialized and dated calibration certification sheet

Ordering Information

Models

January 1989 prices

8506A Thermal RMS Digital Multimeter	$6990
8505A Digital Multimeter	3495

Options (for 8506A & 8505A)**

-02A Ohms Converter [1]	550
-03 Current Converter [1, 2]	550
-05 IEEE-488 Interface [3]	550
-06 RS-232-C Interface [3]	550
-07A Parallel Interface (for DEC PDP11, DR11C, DRV11) [3]	550
-07D Duplex parallel interface for all others (user configured) [3]	550

[1] Cannot install both -02A and -03 in 8506A at the same time

[2] Provides only dc current when installed in 8506A

[3] Only one interface may be installed

Options (for 8505A only)

-01* AC Converter (Average)	650
-09A* AC Converter (True-RMS)	735

**Cannot install both -01 and -09A at the same time*

Accessories (Also see page 127)

MIS-7011K Extender Card	175
MIS-7013K Bus Interconnect & Monitor	85
MIS-7190K Static Test Controller	375
MIS-7191K Test Module	485
M00-260-610 18" Rack Slide Kit (needs M04-205-600)	130
M00-270-610 20" Rack Slide Kit (needs M04-205-600)	130
M00-280-610 24" Rack Slide Kit (needs M04-205-600)	130
M04-205-600 5-1/2" Rack Adapter	95
Y8021 1m, IEEE-488 Shielded Cable	130
Y8022 2m, IEEE-488 Shielded Cable	145
Y8023 4m, IEEE-488 Shielded Cable	155
Y8077 Four Terminal Short	35
Y8133 Universal Test Leads	22

Service & Support

Warranty

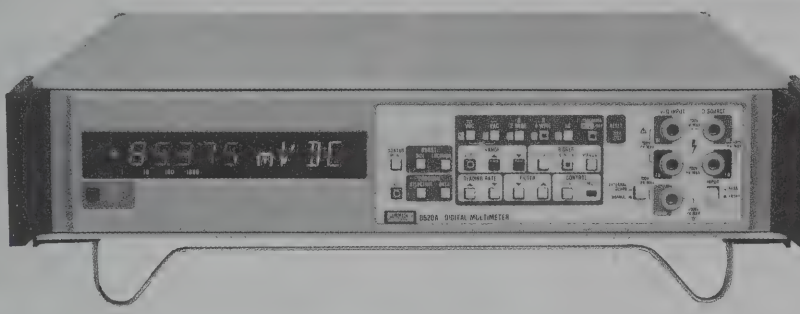
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-8506A Repair (w/calibration)	562
SC1-8506A Repair (cal w/in or out data)	637
SC1-8506A Repair (cal w/in & out data)	712
SC2-8506A Cal (1/yr recommended)	495
SC2-8506A Cal (1/yr w/in or out data)	570
SC2-8506A Cal (1/yr w/in & out data)	645
SC1-8505A Repair (w/calibration)	352
SC1-8505A Repair (cal w/in or out data)	427
SC1-8505A Repair (cal w/in & out data)	502
SC2-8505A Cal (1/yr recommended)	157
SC2-8505A Cal (1/yr w/in or out data)	232
SC2-8505A Cal (1/yr w/in & out data)	307

8520A, 8522A, 8520A/AS-1, 8520A/PRT

GPIB
IEEE-488



(NSN 6625-01-126-3154) **8520A**

Intelligent DMMs for Bench or System

- Dc and ac volts
- 2 and 4-wire ohms
- Conductance
- 520 readings per second
- 20 ppm basic dc accuracy
- Burst memory and math capabilities
- Standard system interfaces: 8520A GPIB/IEEE-488; 8522A: Parallel and BCD
- 8520A/AS-1 MATE certified DMM

The 8520A and 8522A are designed for system and bench applications and have built-in system interface circuits. The performance specifications of the two instruments are almost identical. The principal difference is that the 8520A has an interface compatible with GPIB/IEEE Std 488-1978* and the 8522A has an interface suitable for either BCD or Parallel (binary) applications.

The 8520A/AS-1 and the 8520A/PRT are unique variations of the 8520A. One, the 8520A/AS-1, is compatible with U.S. Government Modular Automatic Test Equipment (MATE) system. And the 8520A/PRT includes a Platinum Resistance Probe for extremely accurate temperature measurements.

Seven standard and seven optional math programs plus a built-in "burst" memory make these multimeters exceptionally intelligent stand-alone units. A choice of dc volts, true-rms ac volts, 2-wire or 4-wire ohms, and the Fluke exclusive conductance function make the instruments very versatile. The conductance function provides a simple way to measure resistance from 10 MΩ to 100,000 MΩ.

The instruments boast 50 ppm basic dc accuracy for 90 days with 5-1/2 digit resolution. A 520 readings-per-second system rate with 4-1/2 digits resolution is standard for high speed measurements. Or make 240 readings per second (with 60 Hz line operation) with 5-1/2 digits resolution. Inputs are switchable from front to rear too.

An unprecedented degree of prompting and operational cues are provided for skilled and unskilled technicians alike. A simple, uncluttered color-coded front panel makes operation easy.

Math Programs

Fourteen pre-programmed functions are available for the 8520A, 8520A/AS-1, 8520A/PRT, and 8522A. The first seven are standard; eight through fourteen are standard on the 8520A/AS-1 but optional on the other models. For systems use, these powerful programs will reduce software overhead greatly. They also simplify and speed testing for ordinary bench applications. Up to three math programs can be chained or stacked for simultaneous use.

The Standard Programs

1 = TEST. Four separate internal test programs do diagnostic checks on analog circuitry, digital hardware and software, and the front panel keys and displays.

2 = ZERO. Eliminates the effect of lead resistance for ohms tests and subtracts low-level dc components in the dc voltage function.

3 = XREF (external reference). Compares an unknown voltage at the front panel to a known rear-panel input. The display is the ratio of the front and rear inputs.

4 = OSR (offset/scale/ratio). Allows you to enter any constant in the formula (X = measurement *minus* offset *times* scale *divided* by ratio) from the keyboard, the memory, or a current reading.

5 Δ PCT (percent deviation). Compares all subsequent readings with a stored nominal value. The display appears as plus or minus a percentage deviation.

6 = PEAK. Constantly monitors the maximum and minimum readings. These values can be recalled as well as the "peak-to-peak" variation.

7 = LIM (limits). Turns the multimeter into a sorting machine. Inputs are sorted and displayed in three ways "High," "Pass" and "Low," based on previously stored upper and lower limits. You can recall the number of high, low, and pass readings, plus the total number of readings.

The Other Programs (Part of Option -010)

8 = STAT (statistics). Computes the mean, standard deviation, and variance of readings taken or data stored in memory registers.

9 = LFAC. A unique way to accurately measure low frequency ac signals from dc to 10 hertz.

10 = dB. Calculates dB, dBm or dBV of a measured value and displays dB.

11 = RTD. Implements equations which convert the resistance of a resistance temperature detector (RTD) to temperature in °C. Readouts in K or °F are also selectable.

12 = JVC (junction voltage Celsius). Computes °C, °F, or K based on inputs from a Fluke 80T-150C Temperature Probe (calibrated for °C).

13 = JVF (junction voltage Fahrenheit). For use with the Fluke 80T-150F (calibrated for °F). Performs the same operations as Program 12.

14 = THMS (thermistor linearization). Converts the resistance of a thermistor to temperature in °C, °F, or K.

Burst Memory (Reading Storage)

The unique burst memory lets you store up to 50 readings at any reading rate (400 readings with Option -010). In fact, the most recent 50 (or 400) readings are always stored in a shift register and available for recall and analysis whenever measurements cease. In the burst mode the storage operation may be independently triggered to capture a particular group of successive readings that may occur before, after, or both before and after the trigger instant. The storage of readings may be delayed after the trigger, as shown in example D, below.

Stored readings can be recalled individually or scanned in sequence for display on the front panel. Or they may be transferred to a controller or computer via the interfaces available in the 8520A or 8522A. Math processing can be applied to readings stored in memory as they are recalled.

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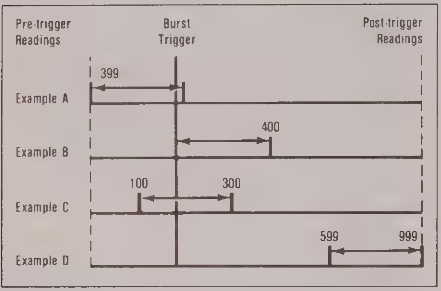
* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

8520A, 8522A, 8520A/AS-1, 8520A/PRT

Burst memory, (400 readings part of Option -010)



With Option -010, the burst memory may capture any group of 400 successive readings that occur within 399 readings prior to and 999 readings following the burst trigger. In example A, only one reading is taken after the trigger point. In example B, 400 readings immediately following the burst trigger are captured. Example C shows storage of 100 readings prior and 300 readings after the trigger point. The last example shows 400 readings being stored commencing 599 readings after the trigger.

8522A Parallel and BCD Interface

Speed and real-time measurement are key system elements available in the 8522A when the Parallel (binary) interface is selected. That interface offers both a three- and a four-wire handshake (switch-selectable) for use with the most popular parallel computer interfaces. A choice of *eight*- or *sixteen*- bit messages are selectable at the rear of the instrument.

The BCD interface emulates BCD remote operation of the Fluke 8375A and 8400A, for the convenience of customers who wish to replace these or any of a large variety of older DMMs in their system. Remote control and data output capabilities are the same as those of the 8375A and 8400A. All but the conductance function may be controlled remotely, plus the range filter and external reference.

Output of readings include five BCD digits, an overrange bit, an overload bit, polarity bit, and three coded range bits. Status output includes function, filter, external reference and remote/local.

8520A/AS-1 – for MATE Systems

The 8520A/AS-1 is equipped with a built-in interface interpreter which makes it compatible with Modular Automatic Test Equipment (MATE) systems. This capability allows a MATE Test Executive to operate the 8520A/AS-1 on the IEEE-488 bus using Control Interface Intermediate Logic (CIIL). It will operate in either the "CIIL Mode," responding only to CIIL commands or in the "native mode," responding to either CIIL commands or IEEE-488 bus commands. Data transmission is increased to 120,000 characters per second for direct memory access using the CIIL mode.

The 8520A/AS-1 was the first candidate module to become MATE certified.

8520A/PRT – Temperature Measurements

The 8520A/PRT is a temperature measurement system consisting of a Rosemount 162N Platinum Resistance Thermometer (PRT) and an 8520A containing a built-in linearization program customized to match the calibration curve of the specific PRT supplied. Temperature is indicated directly in either °C, °F or K with 0.001 degree resolution.

The 8520A/PRT provides a fast, low-cost way of making extremely accurate temperature measurements, or calibratin temperature measurement instruments, in the range of -200°C to +350°C. Systems using four-terminal resistance bridges are much more time-consuming to use, require greater expertise, are limited in their applications, and are far more costly.

Measurements are repeated approximately once per second, making it possible to detect and track fast temperature changes, something impractical to try to do with balance bridges.

See page 443 for more specifications.

Specifications

Technical Specifications

DC Voltage

Range	Full Scale	Resolution	Input Resistance
100 mV	199.999	1 µV	≥10,000 MΩ
1V	1.99999	10 µV	≥10,000 MΩ
10V	16.0100	100 µV	≥10,000 MΩ
100V	130.100	1 mV	10 MΩ
1000V	1024.00	10 mV	10 MΩ

Accuracy: ±(% of Input < Digits)

Range	24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient per °C*
100 mV	0.003+5	0.0065+6	0.011+10	0.0005+0.5
1V	0.003+1	0.006+2	0.011+2	0.0005+0.15
10V	0.002+1	0.005+1	0.009+1	0.0004+0.10
100V	0.003+1	0.007+2	0.012+2	0.0005+0.15
1000V	0.0035+1	0.0065+1	0.011+1	0.0005+0.10

**From 18°C to 0°C or 28°C to 50°C*

High Speed Accuracy: ±(% of Input + LS Bit)*

Range	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient Per °C
100 mV 1V-1000V	0.01 + 1	0.015 + 1	0.001 + 0.1 0.001 + 0.05

** Typical with 60 Hz line, remote operation, 500 readings per second, 2-byte binary output with 14 bits of data.*

Normal Mode Rejection

Line Freq	Filter Setting Time					
	25 ms	50 ms	100 ms	200 ms	500 ms	1s
50 Hz	65 dB	68 dB	71 dB	80 dB	83 dB	86 dB
60 Hz	65 dB	68 dB	71 dB	85 dB	88 dB	91 dB

Common Mode Rejection: True, 100 dB at 50 Hz and 60 Hz with 1 kΩ unbalance in either lead. Effective CMR is equal to normal mode rejection plus true CMR

Maximum Input: ±1000V peak, High to Low or Guard to chassis terminals, and ±200V peak, Guard to Low terminals, for any range

Bias Current: ≤50 pA

Maximum Reading Rate

Operation	Line	Rate	Resolution
Local Remote	50 Hz	200 rdgs/sec*	5-1/2 digits
	60 Hz	240 rdgs/sec*	
Remote	50 Hz 60 Hz	>500 rdgs/sec	4-1/2 digits

**For local operation, 8522A is limited to 1/2 this rate.*

AC Voltage (True RMS)

Input Characteristics

Range	Full Scale	Resolution	Input Resistance
1V	1.99999	10 µV	1 MΩ ≤100 pF
10V	16.0100	100 µV	
100V	130.100	1 mV	
650V	650.00	10 mV	

Accuracy: ±(% Input + % of Full Scale) ac or ac+dc*

Frequency	90 Days 18°C to 28°C			1 Year 18°C to 28°C		
	% of Input	+% FS AC	+% FS AC+ DC	% of of Input	+% FS AC	+% FS AC+ DC
10-20 Hz**	3.0	0.6	0.7	3.5	0.6	0.7
20-40 Hz**	0.5	0.5	0.6	0.6	0.6	0.7
40 Hz-20 kHz	0.1	0.03	0.08	0.15	0.05	0.16
20-100 kHz	1.0	0.3	0.4	2.0	0.6	0.8
100-300 kHz	2.4	0.6	0.6	4.0	0.1	0.1
300 kHz-1 MHz	8.0	2.5	2.5	15.0	5.0	5.0

**From 0.1% of range to full scale*
***With statistics program*

Temp. Coefficient: 18°C to 0°C or 28°C to 50°C, to 20 kHz

AC Mode: ±(0.007% of input + 0.007% FS)/°C

AC+DC Mode: ±(0.007% of input + 0.14% FS)/°C

Maximum Input: ±1000V peak High to Low or Guard to Chassic terminals, and ±200 V peak Guard to Low terminals

Crest Factor: ≥4:1 at full scale, increasing down scale

Maximum Reading Rate: 10 readings per second (rated accuracy, ≥400 Hz)

8520A, 8522A, 8520A/AS-1, 8520A/PRT

Maximum Slew Rate: 177V per µs
Maximum Volt-Hertz Product: 2 x 10^7

Resistance

Input Characteristics

Range	Full Scale	Resolution	Current Through Unknown	Open Circuit Voltage
10Ω	19.9999	100 µΩ	10 mA	7V
100Ω	199.999	1 mΩ	10 mA	
1000Ω	1999.99	10 mΩ	1.0 mA	
10 kΩ	19.9999	100 mΩ	0.1 mA	
100 kΩ	199.999	1Ω	14.5 µA (max)	
1 MΩ	1.99999	10Ω	1.5 µA (max)	
10 MΩ	19.999	1kΩ	1.5 µA (max)	

Maximum Reading Rate

Operation	Line	Rate	Resolution
Local Remote	50 Hz	200 rdgs/sec*	5-1/2 digits
	60 Hz	240 rdgs/sec*	
Remote	50 Hz 60 Hz	>500 rdgs/sec	4-1/2 digits

For local operation, 8522A is limited to 1/2 this rate.

Accuracy: ±(% of Input < Digits)

Range	24 Hrs 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient per °C*
1Ω	0.0045+6	0.0080+7	0.0140+12	0.0007+2.0
100Ω	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
1000Ω	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
10 kΩ	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
100 kΩ	0.0040+2	0.0090+2	0.0140+3	0.0012+0.2
1 MΩ	0.0090+2	0.0160+2	0.0200+3	0.0020+0.2
10 MΩ	0.0300+1	0.0440+1	0.0450+3	0.0030+0.2

**From 18°C to 0°C or 28°C to 50°C*

Conductance

Range: 100 nS (10 MΩ)$^{-1}$
Full Scale: 199.99
Resolution: 0.01 nS (100,000 MΩ)$^{-1}$

Accuracy: ±(% of Input + Digits)

24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient Per °C*
0.4+5	0.05+5	0.06+5	0.004+1

**From 18°C to 0°C or 28°C to 50°C*

Maximum Input: ±400V peak
Maximum Reading Rate: 10 readings per second

External Reference

Operating Range: ±0.5V dc to ±33V dc as long as external reference Low terminal is within ±16.5V of input Low terminal
Input Impedance: 10,000 MΩ between external reference High or Low terminals and input Low terminal

Ratio Accuracy

X-Ref Voltage	Accuracy
16.5V to 33V	±(A + B + 20 ppm)
0.5V to 16.5V	±[A + B + (400 ppm ÷ | Vref |)]

Note: A = DC 10 volt range accuracy
B = Input voltage or resistance range accuracy

Maximum Input: ±180V peak between external reference High or Low and input Low; ±360V peak between externa reference High and Low

Transfer Accuracy

The following accuracy specifications apply when:
- Reading rate is 2 readings per second
- Filter settling time is 500 ms
- Warm-up is at least 2 hours
- Quantity measured has same nominal value and frequency as transfer standard
- Measurements are made in one range
- Standard is checked at least every hour
- Ambient temperature remains within ±1°C

DC Voltage

Range	±(% of Input + Digits)
100 mV	0.0020 + 4
1V	0.0020 + 1
10V	0.0010 + 1
100V	0.0020 + 1
1000V	0.0020 + 1

AC Voltage (all ranges)

Frequency	±(% of Input + % of Full Scale)
10 Hz to 20 Hz	1.0 + 0.2
20 Hz to 40 Hz	0.1 + 0.1
40 Hz to 20 kHz	0.005 + 0.009
20 kHz to 100 kHz	0.100 + 0.030
100 kHz to 1 MHz	0.500 + 0.60

Resistance

Range	±(% of Input + Digits)
10Ω	0.0030 + 5
100Ω	0.0020 + 2
1000Ω	0.0020 + 2
10 kΩ	0.0020 + 2
100 kΩ	0.0020 + 2
1 MΩ	0.0050 + 2
10 MΩ	0.0100 + 1

Conductance (100 nS Range): ±(0.02% of input + 0.02 nS)

General Specifications

IEEE-488 Interface: Standard in the 8520A, 8520A/AS-1 and 8520A/PRT
Parallel (Binary) and BCD Interface: Standard in 8522A
BCD Data Output: Standard 0V and +5V TTL levels positive true, 8-4-2-1 code. Five BCD digits with an overrange bit, overload, polarity, and three coded range bits. The output also includes the state of the instrument (function, filter, external reference, and remote or local).
BCD Remote Control: Standard TTL levels – Logic 1 equals +5V or open, Logic 0 equals 0V or contact closure. Controls all functions (except conductance), range, filter (fast, slow), and external reference. Continuous-command entry and triggered-command entry.
Parallel: In bit parallel operation all features and functions can be accessed through the remote interface. Maximum speed in this mode is 520 readings per second
Format: Select 8 or 16-bit message format with a rear panel switch
Handshake: Handshake configuration is also switch selectable 3- or 4-wire for compatibility with computers, mini-computers, and instrument controllers
Temperature: 0°C to 50°C, operating; -25°C to +75°C non-operatiing; for 8520A/AS1, non-operating temperature range is -40°C to +75°C
Altitude: 10,000 feet operating, 40,000 feet non-operating
Relative Humidity: ≤95% to 25°C, ≤75% to 40°C, ≤40% to 50°C
Shock & Vibration: Meets MIL-T-28800C for Type III, Class 5, Style E
Power: 100, 120, 220, or 240V ac, ±10%, 50 to 60 Hz, ≤50W
Size: 8.9 cm H x 45.7 cm L x 43.2 cm W (3-1/2 in H x 18 in L x 17 in W)
Weight: 9.56 kg (21 lb)
Included: Manual, power cord, rear panel mating connector for analog input, serialized and dated calibration certification sheet

8520A, 8522A, 8520A/AS-1, 8520A/PRT

Ordering Information

Models

January 1989 prices

8520A DMM with IEEE-488 interface	$3350
8522A DMM with BCD and Parallel Interface	5200
8520A/AS-1 DMM for MATE	4595
8520A/PRT Temperature Measurement System	7350

Option (for 8520A & 8520A/PRT)*

-010 Extended Software Package	600

** Included with 8520A/AS-1 and 8522A. Factory or Service Center installation only.*

Accessories (Also see page 127)

Y9111 0.93m, 3 ft Trigger Cable	20
Y9112 1.85m, 6 ft Trigger Cable	20
Y8133 Universal Test Lead Set	22
Y2037 100Ω RTD Temperature Probe	260
Y8021 1m, IEEE-488 Shielded Cable	130
Y8022 2m, IEEE-488 Shielded Cable	145
Y8023 4m, IEEE-488 Shielded Cable	155
Y8597 Interface Adapter for 8375A, 8400A	250
Y8598 3-1/2" Rack Adapter with 22" slides	130
Y8599 3-1/2" Rack Adapter only	70

Conversion of 8520A/AS

Conversion of 8520A/AS to 8520A/AS-1 is available from your Fluke Service Center. Order 8520A/AS/AS1. The price of the conversion is $950.

Service & Support

Warranty

One-year product warranty. (See page 470 for further information on warranty terms and conditions.)

Extended Warranty

SC1-8520A Repair (w/calibration)	$242
SC1-8520A Repair (cal w/in or out data)	317
SC1-8520A Repair (cal w/in and out data)	392
SC2-8520A Cal (1/yr recommended)	126
SC2-8520A Cal (1/yr w/in or out data)	201
SC2-8520A Cal (1/yr w/in and out data)	276
SC1-8522A Repair (w/calibration)	264
SC1-8522A Repair (cal w/in or out data)	339
SC1-8522A Repair (cal w/in and out data)	414
SC2-8522A Cal (1/yr recommended)	126
SC2-8522A Cal (1/yr w/in or out data)	201
SC2-8522A Cal (1/yr w/in and out data)	276

PM 2534 & PM 2535

GPIB IEEE-488

PM 2535

PM 2534 & PM 2535 System Multimeters

- 3-1/2 to 6-1/2 digits
- 100 nV resolution
- 100 measurements/s
- GPIB/IEEE-488 interface standard
- Front or rear input
- Scanner extension

The Philips PM 2534 and PM 2535 Systems Multimeters cover a broad range of applications. While both are suitable for a wide range of general purpose measurements, the PM 2535 offers additional advanced functions for applications demanding data gathering, and fast measurement collecting and processing.

Basic Features

Both the PM 2534 and PM 2535 offer seven measurement functions, front or rear inputs, and 6-1/2 digit guarded sensitive measurements or up to 3-1/2 digit high speed measurements. The units can operate in scan mode under external control via the standard GPIB/IEEE-488* interface.

Extra Capabilities of the PM 2535

As well as the above features, the PM 2535 has built-in data collection, advanced control facilities and calculations including Ax + B, Δ%, dBm and relative measurements. Maximum and minimum values can be stored over a time interval, and warnings can be given if specified limits are exceeded. Burst mode provides up to 150 measurements/sec. Sequence programming allows repetition of the same measurement cycle; thus, when combined with a System 21 module (page 380), allows the PM 2535 to act as a small data logger with no need for dedicated computer control.

Three Million Counts

Philips own VLSI technology is used in the custom analog-to-digital circuitry that gives the PM 2534 and PM 2535 their outstanding performance. The 100 nV resolution on a 300 mV measurement, plus its exceptional short-term stability (0.002%) and long-term accuracy (0.005%) more than substantiates this performance.

To guarantee this measurement integrity they are the only instruments in their class with a true, fully-guarded input. This eliminates parasistic lead voltages and noise which can be several orders of magnitude larger than the measurement resolution of the instrument itself and would otherwise invalidate sensitive measurements.

Fast Measurement and Output

At a touch of the 'speed' button, the PM 2534 and PM 2535 step through 6-1/2, 5-1/2, 4-1/2, and 3-1/2 digit modes, enabling the optimum speed/resolution combination to be selected for every application. At a 3-1/2 digit resolution the instrument makes 100 measurements per second and can transmit the measured values through its standard GPIB interface at the same rate.

This is achieved by the use of two powerful 8-bit microprocessors in parallel – one controlling measurements while the other controls the GPIB interface function. In addition, the measurement and interface functions are galvanically separated, eliminating the possibility of ground loops between different instruments connected to the bus, which can ruin sensitive measurements.

V_{DC} Measurement Speed (including Controller)

Digits	Trigger Mode	Measurements/s
3-1/2	Internal	100
3-1/2	IEEE	50
4-1/2	IEEE	30
5-1/2	IEEE	3
6-1/2	IEEE	0.3

Typical measurement speeds

Measurement Capabilities

The very high performance of these instruments covers more than DC voltages alone. Every aspect of performance including all DMM measuring functions, as well as temperature, are included as standard.

Function	Maximum Resolution	Maximum Range	Accuracy (90-Day)
V_{DC}	100 nV	300V	0.05%
V_{AC}	10 µV	300V	0.2%
I_{DC}	100 nA	3A	0.03%
I_{AC}	10 µA	3A	0.2%
Ω 2-wire	1 mΩ	300 MΩ	0.02%
Ω 4-wire	1 mΩ	3 MΩ	0.02%
°C via Pt-100	0.1°C	-100°C... +850°C	0.3%

Simple English Commands

PM 2534 and PM 2535 are without doubt two of today's friendliest programmable instruments, because they respond to simple English commands rather than complex codes. For example, to measure an unknown AC voltage, it is necessary only to enter the command 'VAC AUTO', and both the AC voltage and autoranging functions are immediately selected.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 2534 & PM 2535

To ensure faultless communication with both user and computer, these instruments also accept numeric ranging values in either decimal or exponential notation, and automatically round-off to the correct range. For example, the commands 'VDC-2' or 'VDC 185E-3' both result in selection of the 300 mV DC range. The PM 2534 and PM 2535 also overcome one major drawback of many other programmable instruments — the amount of 'string splitting' that the controller has to perform to extract the required measurement data. Use of the 'OUT' command gives exactly the required data, eliminating this complex and time-consuming task.

Command	Output string to controller
OUT String	'VDC + 123.4567 E-03'
OUT Numeric	'+ 123.4567 E-03'
OUT N, 6	'123.4'

For applications needing operator instructions, messages can be generated on the DMM display with the "TXT" command.

Operator and Application Friendly

Single button selection of function, range and trigger modes make the PM 2534 and PM 2535 very simple to use. Precise measurements are always made very quickly thanks to the 'NULL' key to compensate for small offsets and the 'FILTER' key to eliminate small instabilities on DC signals.

Access to the GPIB address and mode of operation is under the 'CHECK' function but to prevent unauthorized use in systems application this can be 'locked-out' resulting in a 100% tamper free front panel.

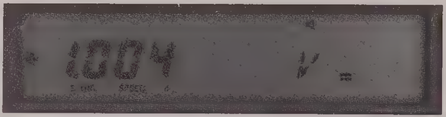
And emphasizing the system-oriented design even further, the standard facility for full electronic calibration allows simple recalibration either via the GPIB bus, or manually, without the need to open the case.

PM 2435 for Collection, Calculation and Control

As for the PM 2534, all the PM 2535's normal measuring functions are directly selectable by a single keystroke. When the calculation, collection or control facilities are required, a simple touch of the SHIFT key reveals a logical and extremely simple user prompting technique. Each key has two color-coded sublevels, with the active level clearly indicated on the display.

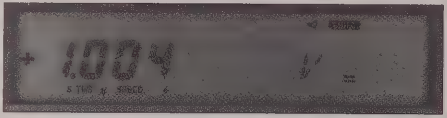
In addition, user prompting messages appear on the display to request the required user input. The example below shows how simple this facility is to use.

Once the required measuring set-up has been programmed, it can also be saved in one of ten non-volatile PROG memory locations, so that the next time it is needed it can simply be recalled by number, rather than having to be reprogrammed.



Normal measurement display

Press SHIFT

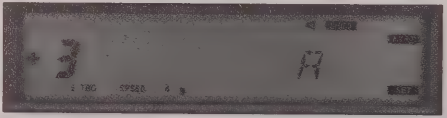


SHIFT appears on display

Press Ax x B

Ax x B and SET appear on display
Display requests setting of A

Press 3



New value of A defined

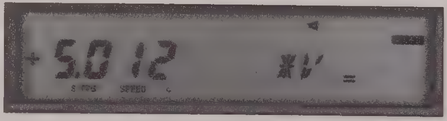
Press ENTER

New value of A entered
Display requests setting of B

Press 2

New value of B defined

Press ENTER



New value of B entered
PM 2535 now shows measuring
Results scaled according to 3x + 2 where x is the measured value

Direct Parameter Display

In many applications, the measured voltage or current is just a function of the real measured parameter, for example where pressure transducers are used. Translating the measured value into the parameter actually required would normally tie-up a computer, and require additional software to be written. The PM 2535 has this capability as standard, enabling the following transformations to be achieved:

Ax + B	For scaling for example transducer outputs with live zeros.
dBm	For direct amplifier gains and losses. The value of the reference resistance is user programmable.
Δ%	For % tolerance measurements for example when matching components. This uses the formula ((X - C) * 100) ÷ C.
ZERO	For absolute deviation measurements from a specified value which can be measured or programmed.
LIMITS	For fast and accurate GO/NO GO measurements within or outside a predetermined range.

Data Collection

At any time, the Minimum or Maximum measurement made in the selected measuring function can be checked by using the MIN/MAX key. The PM 2535 also has a 999-point buffer which is constantly active. This ensures that the last 999 measurements can be reviewed at any time, and ensures that measurements are not lost — you can always go back to them using the RD.BUF. key.

In applications requiring the collection of data following an event, rather than preceding it, the use of the BURST key relocates the internal buffer relative to the trigger point, so that the buffer then acts as a post-trigger memory. In combination with the DELAY facility, this mode enables a measurement to be made every five minutes, for example, over a three-and-a-half day period; ideal for weekend monitoring of test set-ups.

The internal buffer is also valuable when very fast measurements need to be made. One-for-one output of measured values via the GPIB bus can take place at up to 100 measurements/sec., depending on the controller's GPIB specification.

The PM 2535 can measure at up to 150 measurments/sec., and by storing these directly in the internal buffer, more than 6 seconds of high-speed measurements can be collected regardless of the controller's speed.

After such a measurement cycle, all or any selected part of the buffered information can be transmitted at the normal transfer speed of the computer.

Controlling System 21 Modules

Many system applications demand measurements to be made at a number of different points and require large and expensive scanners. But with the PM 2534 and PM 2535, System 21 can be added to any GPIB application to provide a modular and cost-effective solution to system switching. Both the PM 2534 and PM 2535 have a System 21 master unit built-in, enabling them to control the PM 2120 universal switches or the PM 2121 low level switches.

Specifications

Technical Specifications

Volts DC/Amps DC

Ranges	Maximum Resolution	Accuracy: 5-1/2 or 6-1/2 Digits in %Rdng + %Rng 24 Hrs (tcal ±1°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)	Temp. Coeff./°C in %Rdng + %Rng	Input Characteristics
30 mV	100 nV	0.0025 + 0.0014*	0.007 + 0.0017*	0.012 + 0.0017*	0.002 + 0.0005	10 MΩ//30 pF
3V	1 µV	0.0020 + 0.0010	0.005 + 0.0013	0.010 + 0.0013	0.002 + 0.0005	10 MΩ//30 pF
30V	10 µV	0.0025 + 0.0013	0.006 + 0.0017	0.015 + 0.0017	0.002 + 0.0005	10 MΩ//30 pF
300V	100 µV	0.0025 + 0.0010	0.006 + 0.0013	0.010 + 0.0013	0.002 + 0.0005	10 MΩ//30 pF
30 mA	100 nA	0.01 + 0.005	0.03 + 0.005	0.05 + 0.005	0.005 + 0.001	<250 mV drop
3A (<1A) 3A (>1A)	10 µA 10 µA	0.01 + 0.005 0.10 + 0.0	0.03 + 0.005 0.15 + 0.01	0.05 + 0.005 0.20 + 0.01	0.005 + 0.001 0.005 + 0.001	<600 mV drop <600 mV drop

**Valid when using "NULL"*

Operation Modes Scale Length	Speed Measurements/Sec.	Series Mode Rejection 50-60 Hz ±0.1%	50-60 Hz ±1.0%	Common Mode Rejection* DC	50-60 Hz ±0.1%	50-60 Hz ±1%	Common Mode Voltage Influence in %Rng/Volt DC	50/60 Hz + 0.1%	50/60 Hz ±1%
3000000	0.3	>80 dB	>60 dB	>140 dB	>160 dB	>140 dB	—	—	—
300000	3.0	>70 dB	>50 dB	>140 dB	>150 dB	>130 dB	0.00002	0.00002	0.00002
30000	30	>60 dB	>40 dB	>140 dB	>140 dB	>120 dB	0.00002	0.00002	0.00002
3000	100 (150)**	—	—	>140 dB	>80 dB	>80 dB	0.002	0.01	0.01

**Measured with 1 kohm unbalance and guard connected to CM voltage* ***For PM 2535 using internal buffer*

Maximum Input Voltage: 600V peak, 300V continuous
Maximum S.M. Voltage: 140% of selected range
Maximum C.M. Voltage: 350V peak between low and guard; 350V peak between guard and ground
Filters: User-selectable digital
Clip Indication: † is displayed when input circuitry clips during measuring cycle
Null Range: ±100 µV
Protection: 3.15A fuse

Volts AC RMS/AC Amps

Ranges	Maximum Resolution	Input Characteristics	Accuracy: 4-1/2 or 3-1/2 digits in %Rdng + %Rng valid from 1% to 100% of range Frequency Range	24 Hrs (tcal ±5°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)
300 mV 3V	10 µV 100 µV	1.2 MΩ//30 pF	40/400 Hz - 5 kHz	0.10 + 0.10	0.20 + 0.10	0.30 + 0.10
30V 300V	1 mV 10 mV	0.93 MΩ//30 pF	5 kHz-100 kHz per kHz	0.02 + 0.02	0.04 + 0.02	0.06 + 0.02
30 mA	1 µA	<250 mV drop	*40/400 Hz - 1 kHz	0.1 + 0.1	0.2 + 0.10	0.3 + 0.10
3A	100 µA	<600 mV drop	*40/400 Hz - 1 kHz	0.1 + 0.1	0.2 + 0.10	0.3 + 0.1

**Analog Filter on/off*

Operation Modes Scale Length	Speed Measurements/Sec
30000	2.5
3000	25

Protection: 3.15A fuse
Crest Factor: 3.3 at full scale, increasing down scale. Crest factor overload indicated by 1 on display
Temperature Coefficient: <0.03%/°C

Maximum Volt-Hertz Product: 10^7
CMRR: With 1 kΩ unbalance and guard to '0': >120 db for DC signals; >80 db for 50 /60 Hz AC signals
Maximum Input Voltage: 600V peak, 400V continuous

PM 2534 & PM 2535

Ohms (2-Wire and 4-Wire)

Ranges	Maximum Resolution	Accuracy 6-1/2 or 5-1/2 Digits in % Reading + % Range			Input Characteristics (Non-Linear)
		24 Hr (tcal ±1°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)	
3 kΩ 30 kΩ 300 kΩ	1 mΩ 10 mΩ 100 mΩ	0.010 + 0.0033	0.02 + 0.0033	0.03 + 0.0033	1 mA drive 100 µA drive 10 µA drive
3 MΩ 30 MΩ* 300 MΩ*	1Ω 100Ω 10 kΩ	0.020 + 0.0033 0.060 + 0.0033 0.8 + 0.033	0.04 + 0.0033 0.10 + 0.0033 1.6 + 0.033	0.05 + 0.0033 0.15 + 0.0033 2.0 + 0.033	1 µA drive 100 nA drive 10 nA drive

**Only in 2 wire configuration*

Operation Modes Scale Length	Speed Measurements/Sec
3000000	0.25
300000	2.5
30000	25
3000*	65

**Excluding 3 MΩ, 30 MΩ and 300 MΩ ranges*

Temperature (via Pt 100 R to probe)*

Meter Ranges	Resolution	Accuracy	Measurements/Sec
-100 to 850°C	1.0°	0.3% Reading + 0.2°C	30
-100 to +850°C	0.1°C	0.3% Reading + 0.2°C	3

**For optional accuracy see PM 9249/01 RTD Probe*

Maximum Open Circuit Voltage: 10V
Maximum 4-Wire Lead Resistance: 100Ω
Protection 2-Wire Terminals: 250V ac or dc, 350V peak
Protection 4-Wire Terminals: 30V ac or dc, 42V peak
Maximum CM Voltage: 2-Wire: 250V ac or dc, 350V peak between '0' and guard, or between guard and ground; 4-Wire: 30V ac or dc, 42V peak between '0' and ground; guard must be connected to '0'
Linearization: According to DIN 43760
Max Voltage: Between '0' and guard 30V ac or dc, 42V peak

General Specifications

Power Supply: 115V or 230V (±10%)
Line Frequency: 50 Hz or 60 Hz (±1%)
Power Consumption: 20 VA
Safety Class: IEC 348 class I
Dimensions: 280 x 210 x 86 mm (11 x 8.3 x 3.4 in.)
Weight: 2.9 kg (6.2 lbs)
MTBF: 32 000 hrs
Calibration Interval: 1 year
Included with the instrument: Set of safety test leads with probes, spare fuses, operating instructions, service manual

Environmental Conditions

Reference Temperature: 23°C ±1°C
Rated Range of Use: 0...+50°C
Operating Range: 0...+55°C
Storage and Transport: -25...+70°C
Limits of Humidity for Operation: 20...80%
Max Dew Point: +25°C
Included: Set of safety test leads (PM 9266/02), Operating manual, Service manual

Ordering Information

Models

January 1989 prices

PM 2534/013 Standard Instrument	$1095
PM 2535/013 Standard Instrument	1395

Note: The above configurations meet North American power requirements. For other power options, see page 491.

Accessories (Also see page 127)

PM 2193/01 System 21/PM 2534/ PM 2535 Rackmount Adapter	$235
PM 9266/02 Set of Test Leads with Probes, spare fuses	150
PM 9210/00 High Frequency 150 mV Probe 10 kHz ...1 GHz	259
PM 9213 High Frequency 10 mV Probe 10 kHz ...100 MHz	69
PM 9244 AC and DC Current Shunt up to 31.6A	69
PM 9245 AC Current Transformer 10A...150A	65
PM 9246/03 High Tension Probe	149
PM 9249/01 Temperature Probe	150
PM 9264/01 4-wire Test Lead for resistor measurement	85
PM 9265/01 Shielded 3-wire Test Lead	110
PM 9280/02 19-in Rackmount Adapter (3E/132 mm/5.22-in)	175
HM 9606/00 Rackmount Kit for the PM 2534/35 & PM 6660 Family of Counters	95

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

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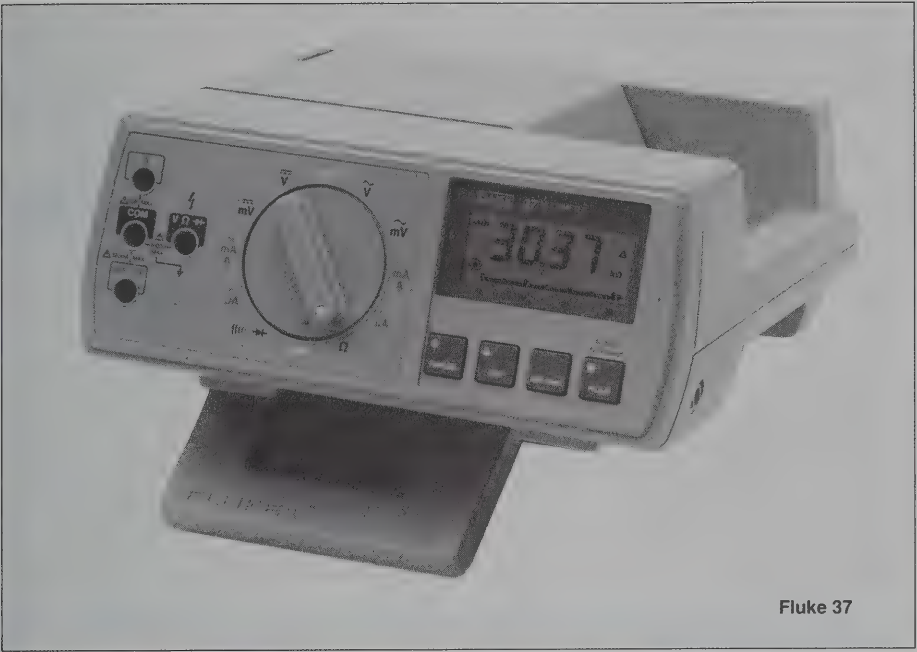
Fluke 37

Fluke 37 Bench Portable Digital Multimeter
Sloped front panel for easy viewing
3200-count digital display, combined with fast 31-segment analog bar graph
"Min-Max" and "Relative" modes
Fast autoranging and Touch Hold® functions
0.1% basic dc accuracy, overload protection to 1000V rms, fused 10A range
Built-in storage compartment for accessories and a detachable tilt stand
Superior shielding against electromagnetic interference (EMI)
Survives 6 kV transients on 660V major ac feeders
Designed to meet UL 1244 requirements

Unique Case Design

The internal design of the Fluke 37 allows the front panel to slope 15 degrees, permitting easy viewing from a number of operating positions. When used in the flat position the Fluke 37 may be stacked with other instruments.

Storage Compartment/ Carrying Handle

A storage compartment for test leads and small accessories is built into the case. Access to the battery and fuses is through a snap-out door inside this compartment. A built-in carrying handle (molded into the case) offers portability when needed.

High Performance

0.1% basic dc accuracy, low millivolt to 1000V ac and dc voltage measurements, 30 kHz ac response, low microamp to 10A ac and dc current measurements, low milliohms to 32 MΩ resistance, up to 10,000 MΩ with conductance.

3200-Count Digital Display

Better accuracy and resolution than a conventional 3-1/2 digit (2000 count) DMM, High contrast liquid crystal display with a wide viewing angle, updated two times per second.

31-Segment Analog Bar Graph

Makes dynamic indications such as peaking, nulling, zero adjustments and capacitor checking. Updates ten times faster than digital readout.

Min-Max & Relative Modes

Min-Max stores the highest and lowest digital reading, allowing a signal to be monitored for seconds, or days. The Relative mode remembers a reading and shows the change (difference) between it and any following readings.

Fast Autoranging

Simplifies and speeds up the use of the meter by instantly selecting the proper range. Selectable manual ranging included.

Touch Hold®

The meter will beep, capture a measurement, and lock it on the digital display until you're ready to view it. Automatically updates with each new stable measurement if preferred for later viewing.

Audible Continuity/Diode Test

Wiring, diode and transistor checks can be done quickly without looking at the display. Easy to hear, mid-frequency beeper (1500 Hz).

EMI Shielding

A unique condutive shield fully encloses all circuitry to provide exceptional protection against electromagnetic interference.

Safety Designed

Extensive overload protection, high energy fuses, fused 10A range, non-metallic case and tilt-stand. All voltage inputs meet the power line surge tests for major feeders as defined in IEEE-587-1980, Category B, which includes simulated lightning and load switching transient pulses up to 6kV superimposed on 660V power lines.

Power

The Fluke 37 is battery powered for true portability. It is also equipped with an input jack which accepts the optional Fluke A81 battery eliminator accessory for continuous operation from line voltage. Typical battery life 1,000 hours.

Standard Equipment

Every meter is packaged with a pair of safety-designed TL70 right-angle test leads, spare fuse, 9 volt battery, and operator's manual.

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Specifications

Technical Specifications

Basic electrical specifications are defined for the temperature range of 18° C to 28° C for one year after calibration. Accuracy is specified as within ±(% of reading plus number of least significant digits).

DC Voltage

Range	Resolution	Accuracy
320.0 mV	100 µV	0.1% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ nominal
Normal Mode Rejection Ratio: >60 dB at 50 and 60 Hz
Common Mode Rejection Ratio: >120 dB at dc, 50 Hz and 60 Hz; ≤1KΩ unbalance
Overload Protection: 1000V rms; 500V rms on 320 mV range
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Resolution	Accuracy		
		40 Hz-2 kHz	2 kHz-10 kHz	10 kHz - 30 kHz
320.0 mV	100 µV	0.5%+3	2%+3	4%+10
3.200V	1 mV			
32.00V	10 mV			
320.00V	100 mV			
1000V	1V	1%+3	3%+3	Not Spec

Extended Frequency Response: Typical -3 dB @ 100 kHz
Conversion Type: AC coupled, average sensing, calibrated to read the rms value of a sinewave
Input Impedance: 10 MΩ nominal, <100 pF
Common Mode Rejection Ratio: >60 dB, dc to 60 Hz, ≤1 KΩ unbalance
Overload Protection: 10^7 Volt-Hertz maximum, 1000V, 500V on 320 mV range
Response Time: ≤2s to rated accuracy

DC & AC Current

Range	Resolution	Nominal Burden Voltage
320.0 µA	0.1 µA	0.5 mV/µA
3200 µA	1 µA	0.5 mV/µA
32.00 mA	10 µA	5.6 mV/mA
320.0 mA	100 µA	5.6 mV/mA
10.00A	10 mA	50 mV/A

DC Accuracy: Within 0.75% + 2
AC Accuracy: Within 1.5% + 2 (40 Hz to 1 kHz)

Overload Protection
10A Range: 15A/600 fuse, 100,000A interrupt rating
mA Range/µA Ranges: 630 mA/250V fuse, 1500A interrupt rating; in series with a 2A/600V fuse, 10,000A interrupt rating
Response Time: ≤2s to rated accuracy

Ohms

Range	Resolution	Accuracy
320.0	0.1Ω	0.3% + 2
3.200K	1Ω	0.2% + 1
32.00K	10Ω	
320.0K	100Ω	
3.200M	1 kΩ	
32.00M	10 kΩ	1% + 1
32.00 nS	0.01 nS	2% + 10

Overload Protection: 500V rms
Test Voltage: <420 mV dc full scale up to 3.2 MΩ; >1.3V up to 32 MΩ. <2.8 V open circuit
Test Current: <1 mA
Response Time: ≤6s to rated accuracy in highest and lowest range; ≤2s for other ranges

Diode Test & Continuity

Diode Test Indication: Displays voltage drop; 0.5 mA nominal test current at 0.6V; 2.0V full scale. Momentary tone for test voltage dropping below 0.7V (typical silicon diode threshold).
Continuity Indication: Continuous audible tone for test resistance below approximately 150Ω
Open Circuit Test Voltage: <3.3V
Overload Protection: 500V rms

General Specifications

Storage Temperature: -55°C to 85°C
Operating Temperature: -15°C to 55°. Operate to -40°C for 20 minutes when taken from a 20°C environment 0°C to 50°C
Temperature Coefficient: 0.1 x the applicable accuracy specification per °C(<18°C or >28°C)
Relative Humidity: ≤90% (≤80% in 32 MΩ range) to 35°C, ≤70% to 50°C
Shock & Vibration: Per MIL-T-28800, Class 3
Electro-Magnetic Interference (EMI): MIL-STD-461 for RS03 (radiated susceptibility to 1V/meter from 14 kHz to 1 GHz) and RE02 (radiated emissions)
MIN/MAX Mode: Records digital display readings (updated twice per sec.)
Digital Display: 3200 counts plus polarity indication updated 2 times per second
Analog Display: 31 segment bar graph plus polarity indication, updated 25 times per second
Maximum voltage to be applied to any terminal: 1000V with respect to earth ground
Battery: 9V NEDA 1604. Symbol when 60 hours remain. 1000 hour typical
Safety: Protection Class II per IEC 348 and ANSI C39.5
Size: 97 mm H x 216 mm W x 231 mm L (3.8 in H x 8.5 in W x 9.1 in L)
Weight: 1.31 kg (2.9 lb)
Included: TL70 test leads, spare fuse, battery and instruction manual

Ordering Information

Model

January 1989 prices

Fluke 37 Multimeter	$249

Accessories (Also see page 127)

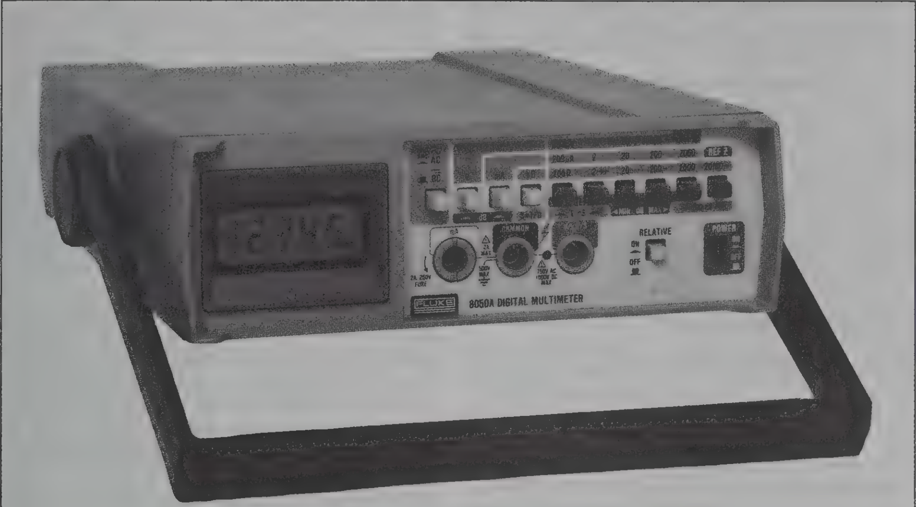
TL 20 Test Lead Set	35
Y8134 Deluxe Test Lead Set	22
Y8140 Test Lead Set	20
A81 Battery Eliminator	20
83RF High Frequency Probe	55
85RF High Frequency Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
80K-6 High Voltage Probe	49
80K-40 High Voltage Probe	85
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400 AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600 AC Current Probe	119
80i-1010 DC/AC Current Probe	229
80i-kW Current/Power Probe	395
LCA-10 Line Current Test Adapter	13

Service & Support

Warranty

Two-year product warranty. See page 470 for further information on warranty terms and conditions.

8050A



(NSN 6625-01-2141) **8050A**

8050A, High Performance Value
4-1/2 digits (20,000 counts)
Nine functions including-Relative reference, dB, Conductance, Diode test
0.03% basic dc accuracy
True-rms from 20 Hz to 50 kHz
Microcomputer-based
Extensive overload protection
Rechargeable battery version available (-01)
Touch-hold probe available (80T-H)
Probes for rf, high voltage, high current available
Factory Mutual approved

The 8050A provides superior performance and measurement capabilities in a low-cost, benchtop instrument. This 4-1/2-digit DMM has the following measurement functions: Dc volts, true-rms ac volts, dc amps, true-rms ac amps, ohms, dBm (with selectable reference impedances) conductance, and diode test. It also has a relative-reference feature that works with all measurement functions.

Relative Reference

When the RELATIVE switch is on, the displayed value is equal to the difference between the present input value and a previously stored reference value.

One application is to null out test lead resistance. The resistance of the test leads is first measured and stored in the 8050A. Subsequently, all displayed values of resistance will be actual values since the stored value of lead resistance will be automatically subtracted. Measurement errors are greatly reduced for low values of resistance (about 1Ω or less).

Another application is measuring the dB gain of the various stages of an audio amplifier. First, the input voltage to the amplifier is measured and stored as the zero dB reference value. Subsequent measurements will show the gain of each stage of amplification. Calculations are not needed; the 8050's microcomputer does it for you.

The relative-reference feature can be used to determine the drift of power supplies, the bandwidth or bandpass of audio devices, and lowpass filter response. This feature makes the 8050A an excellent pass-fail tester for the production line or incoming inspection.

dB Function

While many analog meters will indicate dBm referenced to 600 ohms, the 8050A provides digital read-out of decibels referenced to any one of sixteen impedances from 8 ohms to 1200 ohms. Now there is no need to use manual conversion tables—the internal microprocessor does the calculations for you. A front panel pushbutton and scrolling memory lets you select the reference impedance needed.

A resolution of 0.01 dB (above 1 mV) and high accuracy from 20 Hz to 50 kHz make the 8050A an extremely valuable tool for audio measurements. It can be used to determine the bandwidth of audio amplifiers, filters, audio consoles, etc. With the addition of an optional rf probe, the 8050A can be used on rf communications equipment.

Conductance

Two ranges of conductance extend the resistance-measuring capabilities of the 8050A to 100,000 MΩ, far beyond the capacity of ordinary multimeters. This lets you measure leakage of diodes, pcbs, cables, insulators, even measure transistor beta using a simple test adapter.

True-RMS AC

The 8050A uses a true-rms conversion technique to assure accurate measurement of non-sinusoidal waveforms as well as pure sinewaves. Examples: distorted or modulated sinewaves, squarewaves, sawtooths, noise, and pulse trains with a duty cycle of 10% of higher. Specified accuracy extends from 20 Hz to 50 kHz. Useful measurements go to 200 kHz, the typical -3 dB bandwidth.

Optional Touch-Hold Probe

The 80T-H Probe allows you to "hold" any displayed reading of voltage, resistance, or conductance as long as the control switch on the probe body is depressed. (Not for current or dB measurements.)

Overload Protection

The 8050A has extensive protection against overloads and operator errors. The instrument will accept up to 750V ac or 1000V dc continuously, regardless of the voltage range, or 500V dc when measuring resistance. It will also withstand short-duration transients to 6 kV.

The current input is protected against overloads by a 2A/250V fuse. For accidental connection of high voltage to the current input terminals (such as 480V ac line power) a heavy duty 3A/600V fuse backs up the first fuse.

Optional Accessories

Fluke offers a complete line of optional accessories that enable you to measure rf voltages to 500 MHz, temperature to 1000°C, current to 1000A, or high voltage to 40kV.

8050A

Specifications

Technical Specifications

All accuracy specifications apply for one year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of 90% or less.

DC Voltage*

Ranges: ±200 mV, ±2V,±20V, ±200V & ±1000V
Resolution: 10 µV on lowest range, 0.1V on 1000V range
Accuracy: ±(0.03% of reading + 2 digits) all ranges
Input Impedance: 10MΩ, ≤100 pF, all ranges
Normal Mode Noise Rejection: ≥60 dB at 50 Hz or 60 Hz
Common Mode Noise Rejection: ≥90 dB at dc, 50 Hz and 60 Hz with 1 kΩ unbalance
Overload Protection: 1000V dc or peak ac, continuous, except 10 seconds maximum on the 200 mV and 2V ranges
Response Time: 1 second maximum, to rated accuracy within a range

** DC voltage can also be measured using the dB mode with 0.01 dB resolution between 5% of range and full range*

AC Voltage (True-RMS, AC Coupled)

Voltage Readout: From 5% to 100% of range

Range	Resolution	Accuracy: ±(% of Rdg+Digits) 20 Hz*	45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
200 mV	10 µV	1% +10	0.5% +10		1% +10	5% +30	
2V	100 µV						
20V	1 mV						
200V	10 mV						
750V	100 mV		Not specified				

**Typically 3 to 5 digits of "rattle" will be observed at 20 Hz at full scale*

dB Readout: From 5% to 100% of range

Input Voltage	dBm 600Ω Ref	Range	Accuracy 20 Hz	45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
0.77mV -2mV	-60 to -52	200 mV*`	±0.5 dBm					N/S
2mV -2V	-52 to +8							
0.1V -2V	-18 to +8	2V*	±0.25 dBm	±0.15 dBm		±0.25 dBm	±0.75 dBm	
1V- 20V	+2 to +28	20V						
10V- 200V	+22 to +48	200V						
100V- 750V	+42 to +60	750V			Not specified (N/S)			

** When 200 mV range is selected, 8050A autoranges for best accuracy for inputs up to 2V*

dB Resolution: ±0.01 dB from 5% to 100% of range; 0.1 dB from 1% to 5% of range; 1.0 dB below 1% of range
Decibel Reference Impedances: Fifteen user-selectable impedance reference levels are provided to reference a 0 dBm, 1 mW level (50Ω, 75Ω, 93Ω, 110Ω, 125Ω, 135Ω, 150Ω, 250Ω, 300Ω, 500Ω, 600Ω, 800Ω, 900Ω, 1000Ω, 1200Ω. An 8Ω impedance reference level is provided to reference 0 dBW. (dBV = 1000Ω)
Input Impedance: 10 MΩ, ≤100 pF, all ranges
Extended dB Response: Typically -72 dBm (600Ω ref) ±1 dB to 10 kHz
Useful Frequency Range: Typically -3 dB at 200 kHz
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Common Mode Noise Rejection: 90 dB at 50 Hz and 60 Hz with 1kΩ unbalance
Overload Protection: 750V rms or 1000V peak continuous, except 10 seconds maximum on the 200 mV and 2V ranges, not to exceed a volt-hertz product of 10^7 (e.g., 200V at 50 kHz)
Response Time: 2 seconds max to rated accuracy within a range

DC Current

Range	Resolution	Accuracy: (5% to 100% of Range	Burden Voltage
200 µA	10 nA	±(0.3% of rdg + 2 digits)	0.3V max
2 mA	100 nA		
20 mA	1 µA		
200 mA	10 µA		
2000 mA	100 µA		0.9V max

Overload Protection: 2A/250V and 3A/600V fuses in series

AC Current (True-RMS, AC Coupled)

Range	Resolution	Accuracy: ±(% of Reading + Digits)* 20 Hz**	45 Hz	2 kHz	10 kHz	20 kHz
200 µA	10 nA	2% + 10		1% + 10	2% + 10	
2 mA	100 nA					
20 mA	1 µA					
200 mA	10 µA					
2000 mA	100 µA				Not spec'd	

**Accuracy applies from 5% to 100% of range*
***Typically 3 t o 5 digits of "rattle" will be observed at 20 Hz at full range*

Burden Voltage: 0.3V rms max, 200 µA through 200 mA range; 0.9V max on 2000 mA range
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Overload Protection: 2A/250V and 3A/600V fuse in series

Resistance

Range	Resolution	Accuracy	Full Scale* Voltage
200Ω	0.01Ω	±(0.1% reading +2 digits+0.02Ω)	0.19V
2 kΩ*	0.1Ω		1.2V
20 kΩ	1Ω	±(0.05% reading +2 digits)	0.2V
200 kΩ*	10Ω		2V
2000 kΩ	199Ω	±(0.25% reading +3 digits)	0.2V
20 MΩ*	1 kΩ		2V

**Diode Test ranges*

Diode Test: The three diode test ranges are marked with a diode symbol and have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with the larger diode symbol. The three non-diode test ranges will not turn on silicon junctions when making in-circuit resistance measurements
Open Circuit Voltage: Less than 3.5V on all ranges
Input Protection: 500V dc or rms ac on all ranges
Response Time: (To rated accuracy) 10 seconds maximum on 20 MΩ range, 2 seconds maximum on all other ranges

Conductance

Range	Resolution	Accuracy
2 mS	0.1 µS	±(0.1% of reading + 5 digits)
200 nS	0.01 nS	±(0.5% of reading + 20 digits)

Equivalent Resistance
2 mS Range: 500Ω to 10 MΩ
200 nS Range: 5 MΩ to 100,000 MΩ
Open Circuit Voltage: Less than 3.5V on both ranges
Input Protection: 500V dc or rms ac on all ranges

Relative Reference

An input applied when the RELATIVE button is depressed is held as "0" reference point. Subsequent readings indicate deviations ± from this point.
Accuracy: Error will not exceed the sum of the errors for the two measurements.

General Specifications

Common Mode Voltage: 500V dc or peak ac max

Temperature: 0°C to 50°C, operating; -40°C to +70°C non-operating, except -40°C to +50°C with batteries

Temperature Coefficient: ≤0.1 times the applicable accuracy specification per °C from 18°C to 0°C and from 28°C to 50°C

Relative Humidity: ≤70% to 50°C or ≤90% to 35°C, except 2000 kΩ, 20MΩ, and 200 nS ranges where it is <80% to 35°C

Safety: IEC 348, Protection Class I when operated from supply mains or Protection Class II when operated from internal batteries. Factory Mutual 3820 Approved. CSA 556A Certified.

Power: 90 to 110V ac, 105 or 132V ac, or 200 to 264V ac, 47 to 440 Hz, factory-configured for customer-specified voltage. With rechargeable battery version (-01), the line voltage range is field-changeable. 4W max, 6W with -01 version.

Batteries: NiCd batteries are installed in version -01. They provide 10 hours of typical operation on a full charge. Recharge takes 14 hours. Can run on ac line while charging

Size: 22 cm W x 6 cm H x 25 cm L (8.5 in W x 2.5 in H x 10 in L)

Weight: 1.08 kg (2.38 lb) for standard model

Included: Manual, line cord, test leads (TL70) and statement of calibration practice

Ordering Information

Models

January 1989 prices

8050A DMM	$429
8050-01 DMM w/rechargeable batteries	469

Accessories (Also see page 127)

TL20 Test Lead Set	35
TL70 Test Lead Set	8
Y8132 Replacement Test Leads	11
Y8134 Deluxe Test Lead Set	22
Y8140 Slim Test Leads, w/needle points	20
C86 Ruggedized Carrying Case	20
Y8205 Carrying Case w/shoulder strap	35
80T-H Touch Hold Probe	59
83RF 100 MHz RF Probe	55
85RF 500 MHz RF Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
80K-6 High Voltage Probe	49
80K-40 High Voltage Probe	85
80J-10 Current Shunt	35
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400 AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600 AC Current Probe	119
80i-1010 DC/AC Current Probe	229
80i-kW Current/Power Probe	398
M00-200-611 3-1/2" Rack Adapter, Offset	50
M00-200-612 3-1/2" Rack Adapter, Center	50
M00-200-613 3-1/2" Rack Adapter, Dual	60

Service & Support

Warranty

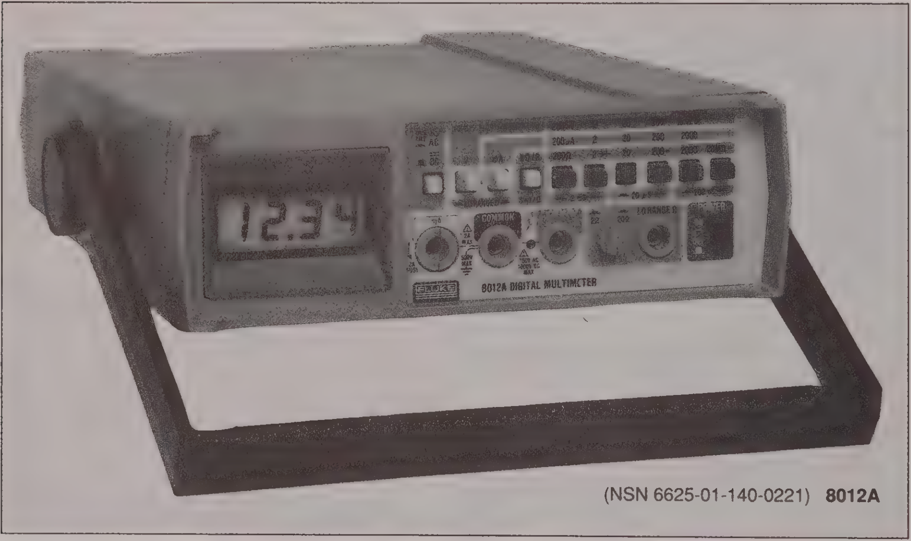
One-year product warranty. (See page 470 for further information on warranty terms and conditions.)

Extended Warranty

SC1-8050A Repair (w/calibration)	$47
SC1-8050A Repair (cal w/in or out data)	82
SC1-8050A Repair (cal w/in and out data)	117
SC2-8050A Cal (1/yr recommended)	35
SC2-8050A Cal (1/yr w/in or out data)	70
SC2-8050A Cal (1/yr w/in and out data)	105
SC1-8050A-01 Repair (w/calibration)	50
SC1-8050A-01 Repair (cal w/in or out data)	85
SC1-8050A-01 Repair (cal w/in & out data)	120
SC2-8050A-01 Cal (1/yr recommended)	35
SC2-8050A-01 Cal (1/yr w/in or out data)	70
SC2-8050A-01 Cal (1/yr w/in and out data)	105

8010A & 8012A

(NSN 6625-01-018-2544) **8010A**



(NSN 6625-01-140-0221) **8012A**

8010A & 8012A
3-1/2 digits (2000 counts)
Seven functions, including – Conductance, Diode Test
0.1% basic dc accuracy
True-rms ac, from 45 Hz to 50 kHz
10A range (8010A only)
2Ω and 20Ω range (8012A only)
Optional touch-hold probe (80T-H)
Extensive overload protection
Rechargeable-battery model (-01)
Extended measurements with optional accessories
Factory Mutual approved

The 8010A and 8012A are 3-1/2 digit portable/bench DMMs, that offer exceptional performance and features at a low cost. Measurement functions include: dc Volts, true-rms ac Volts, dc amps, true-rms ac amps, ohms, conductance, and diode test. The difference is that only the 8012A features two low-resistance ranges (2 ohms and 20 ohms) and only the 8010A features a 10A current range. Rechargeable-battery versions are available as Models 8010A-01 and 8012A-01. The 8010A and 8012A operate on ac line power only.

True-RMS

A Fluke-manufactured true-rms converter assures accurate measurements of non-sinusoidal voltage or current waveforms such as squarewaves (crest factor of 1 to 1). This custom hybrid provides low noise and a wide bandwidth. Accuracy is specified to 50 kHz, but the typical -3 dB bandwidth is 200 kHz.

Conductance

This unique and highly useful function makes resistance measurements as high as 10,000 M ohm possible. Since conductance, which is expressed in Siemens (S), is the inverse of ohms (1/Ω), a simple conversion of the DMMs conductance reading yields resistance. The conductance function is useful for checking high value resistors, leakage in connectors, cables, printed circuit boards, diodes, photodiodes, etc. Even the beta of a transistor may be measured using a simple adapter.

10A Range **(8010A Only)**

The 8010A has a 10 ampere ac or dc current range for applications that require measuring more than 2 amperes.

Low Ohms **(8012A Only)**

The 8012A has two additional ranges of low resistance—2 ohms and 20 ohms. Along with the conductance function, that gives you a resistance range of 0.001Ω to 10,000MΩ! There are not many resistance measurements that the 8012A can't handle.

The two low-resistance ranges are suited for measuring transformer windings, cables, heating elements, coils, small-value resistors, and many other devices. Lead resistance is nulled out using a front panel control so that only the unknown resistance is measured.

Optional Touch-Hold Probe

The 80T-H probe lets an operator "hold" the displayed reading by simply depressing a button on the probe's body. The reading will not change until the button is released. The 80T-H can be used as a normal probe at other times. It works for voltage, resistance, and conductance measurements.

Overload Protection

When measuring resistance or conductance, up to 500 volts may be applied with no instrument damage. Voltage inputs can handle 1000V dc or peak ac and transients up to 6 kV. The 2A current input is protected with two in-series fuses—2A/250V and 3A/600V. In normal overload situations, only the common 2A/250V fuse will blow. The 3A/600V back-up fuse protects the DMM should the 2A/250V fuse ionize when accidentally attached to a source of more than 250 volts—like a 480-volt power line.

Extended Measurements

Optional accessories enable you to extend the measurement capabilities of the 8010A and 8012A. For example, measure current to 600A, rf voltage to 500 MHz, voltage to 40 kV, and temperature to 1000°C (1832°F).

Specifications

Technical Specifications

All accuracy specifications are for one year after purchase or recalibration when operated in a temperature range of 18°C to 28°C.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V
Resolution: 100 µV on lowest range 1V on 1000V range
Accuracy: (±0.1% of reading + 1 digit) on all ranges
Input Impedance: 10 MΩ on all ranges
Normal Mode Noise Rejection: ≥60 dB at 60 Hz or 50 Hz
Commom Mode Noise Rejection: ≥90 dB at dc, 50 Hz, and 60 Hz, with 1 kΩ unbalance
Overload Protection: To 1000V dc or peak ac on any range
Response Time: 1 second maximum

AC Voltage (True RMS, AC Coupled)

Range	Resolution	Accuracy: ±(% of Reading + Digits)				
		45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
200 mV	100 µV	0.5% + 2		1.0% + 2	5% + 3	
2V	1 mV					
20V	10 mV					
200V	100 mV					
750V	1V	0.5% + 2	Not specified			

Accuracy applies from 5% to 100% of range

Useful Frequency Range: Typically ±3 dB at 200 kHz
Input Impedance: 10 MΩ in parallel with <100 pF
Commom Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz with 1 kΩ unbalance
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Overload Protection: To 750V rms, 1000V peak, not to exceed 10^7 volt hertz product (10 seconds maximum on 200 mV and 2V ranges)
Response Time: 2 seconds maximum

Resistance

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Full Scale Voltage	Max Test Current
2Ω	1 mΩ	1.0% + 2	0.02V	10 mA
20Ω	10 mΩ	0.5% + 2	0.2V	10 mA
Note...above ranges in 8012A only				
200Ω	0.1Ω	0.2% + 1	<0.25V	1.30 mA
2 KΩ*	1Ω		>1.0V	1.30 mA
20 kΩ	10Ω		<0.25V	10.0 µA
200 kΩ*	100Ω		<1.0V	35.0 µA
2000 kΩ	1 kΩ	0.5% + 1	<0.25V	0.10 µA
20 MΩ*	10 kΩ		>1.5V	0.35 µA

Diode Test ranges

Diode Test: The three diode test ranges are marked with a diode symbol and have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with the larger diode symbol. The non-diode test ranges will not turn on silicon junctions when making in-circuit resistance measurements.
Open Circuit Voltage: <3.5V on all ranges except <16V on 2Ω and and 20Ω ranges
Input Protection: To 300 V dc or rms on 2Ω and 20Ω ranges. 500V dc on all other ranges
Response Time: 1 second on all ranges except 2000 kΩ and 20 MΩ where time is 4 seconds, maximum

Conductance

Conductance is the inverse of ohms (1/Ω) and is expressed in Siemens (S), formerly mhos

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Full Scale Voltage	Max Test Current
2 mS	1 µS	0.2% + 1	<3.5V	1.3 mA
20 µS	10 nS	0.2% + 1	<1.0V	10 µA
200 nS	0.1 nS	1.0% + 10	<1.0V	0.1 µA

Equivalent resistance

2 mS Range: 500Ω to 1 MΩ
20 µS Range: 50 kΩ to 100 MΩ
200 nS Range: 5 MΩ to 10,000 MΩ

Input Protection: To 500V dc or rms on all ranges

DC Current

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Burden Voltage
200 µA	0.1 µA	0.3% + 1	0.3V max
2 mA	1 µA		
20 mA	10 µA		
200 mA	100 µA		
2000 mA	1 mA		0.9V max
10A*	10 mA	0.5% + 1	0.5V max

This range in 8010A only

Overload Protection: 2A, 250V front panel fuse in series with 3A/600V front panel fuse. 10 ampere range in 8010A not fused, 12A maximum
Response Time: 1 second maximum

AC Current (True-RMS, AC Coupled)

Range	Accuracy: ±(% of Reading + Digits)*				Burden Voltage
	45 Hz	2 kHz	10 kHz	20 kHz	
200 µA	1% + 2		2% + 2		0.3V max
2 mA					
20 mA					
200 mA					
2000 mA	1% + 2	Not specified			0.9V max
10A**					0.5V max

Applies from 5% to 100% of range
***This range in 8010A only*

Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Response Time: 2 seconds maximum
Other Specifictions: Same as for dc current

General Specifications

Display: 3-1/2 digit (2000 counts), LCD, autozero, autopolarity
Common Mode Voltage: 500V dc or peak ac, maximum
Touch and Hold: Holds a voltage or resistance reading when the mA jack is monentarily shorted to COMMON. Accessory probe 80T-H is recommended.
Temperature: 0°C to +50°C, operating; -40°C to +60°C non-operating, except -40°C to +50°C with batteries
Temperature Coefficient: <0.1 times the applicable accuracy specification per °C, from 18°C to 0°C and 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤90% to 35°C except for 2000 kΩ 20 MΩ, and 200 nS ranges where it is ≤80% to 35°C
Power: 90 to 132 ac or 200 to 264V ac, 50 or 60 Hz, 2W for standard models. With battery version (-01), voltage and frequency range is selectable with internal switches, 3.5W.
Batteries: Rechargeable NiCd batteries and recharge circuits installed in version -01. Recharge time approximately 14 hours. "BT" on display appears when approximately 1/2 hour of operation remains. Fifteen to thirty hours of operation typical of full charge, depending on functions used
Size: 6 cm H x 22 cm W x 25 cm D (2.5 in H x 8.5 in W x 10 in D)
Weight: 1.08 kg (2.38 lb) for standard models. 1.42 kg (3.13 lb) for version -01 with batteries
Included: Manual, line cord, test leads (Y8131), statement of calibration practice

8010A & 8012A

Ordering Information

Models

January 1989 prices

8010A DMM w/10A Range	$329
8010A-01 DMM w/Batteries	369
8012A DMM w/2Ω and 20Ω Range	359
8012A-01 DMM w/Batteries	399

Accessories (Also see page 127)

Y8131 Replacement Test Leads	11
Y8133 Deluxe Test Lead Set	22
Y8140 Slim Test Leads w/needle points	20
C86 Ruggedized Carrying Case	20
Y8205 Soft Carrying Case	35
80T-H Touch-Hold Probe	59
83RF 100 MHz RF Probe	55
85RF 500 MHz RF Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
80K-6 High Voltage Probe	49
80K-40 High Voltage Probe	85
80J-10 Current Shunt	35
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-600 Ac Current Probe	119
M00-200-611 3 1/2" Rack Adapter, Offset	50
M00-200-612 3 1/2" Rack Adapter, Center	50
M00-200-613 3 1/2" Rack Adaper, Dual	60

Service & Support

Warranty

One year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-8010A Repair (w/calibration)	20
SC1-8010A Repair (cal w/in or out data)	35
SC1-8010A Repair (cal w/in and out data)	50
SC2-8010A Cal (1/yr recommended)	27
SC2-8010A Cal (1/yr w/in or out data)	42
SC2-8010A Cal (1/yr w/in and out data)	57
SC1 8010A-01 Repair (w/calibration)	24
SC1 8010A-01 Repair (cal w/in or out data)	39
SC1 8010A-01 Repair (cal w/in and out data	54
SC2 8010A-01 Cal (1/yr recommended)	27
SC2 8010A-01 Cal (1/yr w/in and out data)	42
SC2 8010A-01 Cal (1/yr w/in and out data)	57
SC1-8012A Repair (w/calibration)	20
SC1-8012A Repair (cal w/in or out data)	35
SC1-8012A Repair (cal w/in and out data	50
SC2-8012A Cal (1/yr recommended)	27
SC2-8012A Cal (1/yr w/in or our data)	42
SC2-8012A Cal (1/yr w/in and out data)	57
SC1-8012A-01 Repair (w/calibration)	24
SC1-8012A-01 Repair (cal w/in or out data)	39
SC1-8012A-01 Repair (cal w/in and out data)	54
SC2-8012A-01 Cal (1/yr recommended)	27
SC2-8012A-01 Cal (1/yr w/in or out data)	42
SC2-8012A-01 Cal (1/yr w/in and out data)	57

PM 6303

PM 6303 Automatic RCL Meter

- Easy-to-read LCD display
- Extremely fast automatic operation
- Displays component value, measurement units and equivalent circuit
- All displays appear simultaneously
- One or two push-button selection of nine different parameters
- Two- or four-wire connection
- SMD Testing via Optional Test Attachment

Fast Operation, Clear Display

The PM 6303 automatic RCL meter will rapidly determine the value, electric dimension and equivalent - circuit of passive components to a very high order of accuracy, and over a wide range. The measured value, together with the appropriate unit of measurement and the equivalent circuit-graphics, are easily read on a large 4-digit liquid crystal display.

Rapid Connection

Connection of a component to be tested is effected easily and rapidly, using either a two- or four-wire connector or an optional test attachment. Less than one second after connection, the dominant component's measured value, its effective dimension and its equivalent circuit, will be clearly displayed. For example: when measuring a coil having a Q-factor of 1, both the series inductance and resistance and the equivalent circuit-graphics will be displayed almost instantly. Apart from using the auto mode of the PM 6303, it is possible to select from a maximum of nine differing parameters (D, Q, Rp, Rs, Z, Ls or Lp, Cs or Cp and Cs 2V bias), using only two push-buttons.

Universal Capability

Features like these make the PM 6303 an ideal instrument for a very wide range of applications; educational-institutes R & D laboratories, specialized service centers, or in general-purpose workshops. Its automatic operation, coupled with a direct digital readout, also makes the PM 6303 a most attractive proposition for use in research, development, and in quality-control; manufacturing engineers, too, will find the PM 6303 a most useful aid in batch-sampling techniques.

Connection Facilities

- 2 sockets for measuring voltage (HI) Drive and Sense connection
- 2 sockets for measuring current (LO) Drive and Sense connection
- 1 socket guard connection

Parameter Selection

- 2 push-buttons for stepping from item to item in the parameter menu.
- 1 push-button to reset to RCL AUTO mode in which the dominant component is measured.

Parameters

- Dominating component R, C or L (autoselection)
- Q
- D
- Rp
- Rs
- Z
- Cp, Lp
- Cs, Ls
- Cp Biased (internally generated DC voltage)

Optional Accessories

When making measurements of already mounted components, connection between the PM 6303 and the component to be tested can be difficult. The problem is easily overcome by the use of the 4-wire test cable PM 9541. This consists of a cable fitted at one end with Kelvin clips, the other end fitted with a Kelvin connector which plugs into the front panel socket on the PM 6303.

In addition, and especially useful for testing batches of individual components of all different physical sizes, there is the 4-wire RCL adapter, PM 9542. This is a box-mounted set of 'slide-in' connectors having a similar cable end to PM 9541.

Also available is a fixture for all types of SMDs (Surface Mounted Devices). It plugs into the PM 9542 and allows measurment on and testing of all shapes and sizes of SMDs. A direct readout of the component type and value is displayed on the PM 6303, together with a display of the equivalent-circuit symbol for the component. As for other components, a 4-wire technique is used for measurment, ensuring high accuracy even for low-impedance components.

All three accessories may be seen on the following page.

Specifications

Technical Specifications

General

Display: Large 18mm, 4-digits LCD
Dimension Indications: Ω, kΩ, MΩ, pF, nF, µF, mF, µH, mH, H, kH
Out of Range Indication: 4 middle digit segments flashing

Measuring Ranges

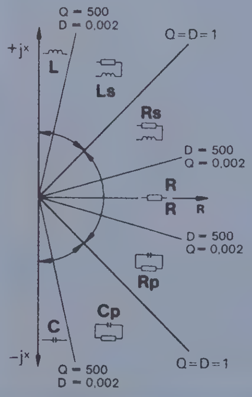
Resistance: Rp, Rs, Z 0.000Ω...200 MΩ
Capacitance: Cp, Cs 0.0 pF...100 mF
Inductance: Lp, Ls 0.0 µH...32 kH
Quality Factor: Q 0.002...500
Dissipation Factor: D 0.002...500

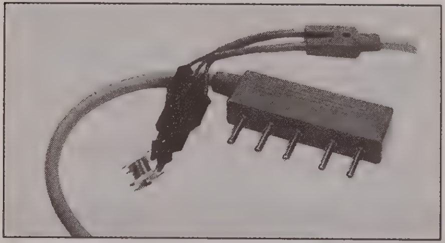
PM 6303

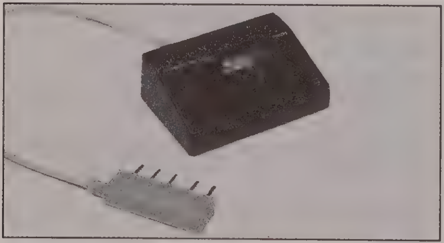
Equivalent circuits
– 7 Equivalent circuits

D > 500
D < 0.002, Q > 500
Q > 500, no display of the secondary parameter

D or Q Q=D=1	parameter selection
≤ 500	RCL AUTO, Cp, Rp, D, Z
≤ 500	Cs, Rs
≤ 500	RCL AUTO, Ls, Rs, Q, D, Z
≤ 500	Lp, Rp




4-wire test cable PM 9541 (optional)


4-wire RCL adapter PM 9542 with SMD adapter PM 9542SMD (optional)

PM 6303 is extremely versatile making it a valuable measurement tool in industry, service workshop or education.

	PM 9541	PM 9542*
Performance characteristics:		
DUT-connection	by two Kelvin clips	by Kelvin contacts in the test pods
Short-circuit inductance	0.1 µH typical 10.3 µH max.	<0.1 µH max.
Mechanical specifications:		
Cable length	600 mm	600 mm
Case dimension	—	50 x 145 x 95 mm
Weight	0.2 kg	0.6 kg

** Alone or combined with 9542SMD*

Maximum Resolution per Range

Resistance: 1 mΩ
Capacitance: 0.1 pF
Inductance: 0.1 µH
Quality/Dissipation Factor: 0.001
Measuring Accuracy: Basic Error ±0.25% ±1 digit
Measuring Frequency: 1 kHz ±0.025%
DUT Stress: ≤5 mA, ≤2V
(linked to a 2 V_{RMS} source with an internal resistance of 400Ω)
Type of Connectors: 4 mm sockets
2 sockets for measuring voltage (HI)
Drive and Sense connection
2 sockets for measuring current (LO)
Drive and Sense connection
1 socket guard connection
Measurement Update Rate: Approx. 2 measurements per second
Zero Capacitance Adjustment:
Co-trim by means of screwdriver adjustment on front panel.
Maximum Adjustable Capacitance: 5 pF

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Frequency: 50...100 Hz ±5%
Power Consumption: 13W

Environmental Capabilities

Ambient Temperatures
Reference Value: +23°C ±1°C
Operation: +5°C + 40°C
Storage and Transport: -40°C...+70°C
Dimensions: 310 mm W x 140 mm H x 310 mm L (12.2 in W x 5.15 in H x 12.2 in L)
Weight: 4.8 kg (10.6 lb)
Included: Two-terminal fixture and operating manual

Ordering Information

Model
January 1989 prices

PM 6303/008 Automatic RCL Meter	$1295

Accessories (Also see page 127)

PM 9541/00 Four-wire test cable	55
PM 9542 RCL test adapter	250
PM 9542SMD SMD adapter for PM 9542	90

Note: The above configurations meet North American power requirements. For other power options, see page 491.

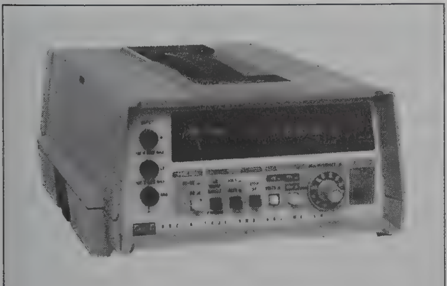
8920A/8921A/8922A

GPIB
IEEE-488

8920A

8920A/8921A/8922A Wideband Digital Voltmeters

- True-rms ac with readout in volts or dB
- Ac or ac + dc measurements
- Autoranging
- Selectable dBm reference impedance
- Analog display for peak/null adjustments
- Rear panel linear analog output (Models 8920A & 8922A)
- Relative dB measurements
- 10 Hz to 20 MHz or 2 Hz to 11 MHz (Model 8922A)
- 180 µV to 700V



8921A

8922A

Choice of Bandwidth

Bandwidth capabilities of the 8920-Series Voltmeters encompass many applications, from testing high-frequency oscillators, attenuator flatness and amplifier frequency response to microphone levels, phono-pickup devices, vibration tests and wideband noise levels to list only a few. Models 8920A and 8921A cover a bandwidth of 10 Hz to 20 MHz. The 8922A offers low-frequency capabilities in the 2 Hz to 11 MHz bandwidth and a switchable 200 kHz low pass filter which eliminates unwanted high-frequency noise from the measured signal.

True RMS Converter

The heart of all 8920-Series Voltmeters is Fluke's monolithic thermal converter which can measure rms values of an ac signal. This patented semiconductor circuit balances the heating power of a dc feedback signal against the heating power of the ac input voltage, producing a true rms equivalent dc output. This unique converter enables Fluke voltmeters to provide wideband, low-noise, accurate measurements at a low cost.

Selectable dBm Reference Impedance

Fluke's 8920-Series Voltmeters permit an operator to select any one of 12 reference impedances from 50Ω to 1200Ω and to digitally read out dB values referenced to the selected level. Input impedance is constant at 10 MΩ for all settings of the dB reference control. This minimizes circuit loading and allows the operator to add the appropriate termination externally. Zero dB corresponds to 1 mW for each of the selectable levels.

AC or AC + DC Functions

The input coupling capabilities of the 8920-Series Voltmeters help solve difficult measurement problems. Without these features, whenever an operator is required to measure a signal which (1) is not symmetrical, (2) has unequal excursions above and below zero, or (3) has a dc component, it is necessary to go through a series of computations to determine the actual rms voltage value. First, the signal has to be measured with a dc voltmeter (providing its ac rejection is sufficient) and then with an ac voltmeter. Finally, the sum of the squares of the two readings must be calculated and the square-root extracted from the result. Failure to consider the dc component by using only an ac-coupled meter can result in substantial error.

Relative dB Measurements

The relative reference feature of the 8920-Series Voltmeters allows direct readings of gain or attenuation. Depressing the REL switch sets the existing dB reading to zero, establishing the input voltage level as the relative dB reference. Subsequent readings of higher voltages will be displayed as +dB, lower voltages as -dB.

8920A/8921A/8922A

Autoranging

Fluke's autoranging feature allows you to carry out your testing without having to change ranges manually. A range can be placed on HOLD or manually stepped up to a higher range. On HOLD, the meter will remain in a given range regardless of changes in input levels. On STEP UP, the meter will increase ranges step-by-step until the switch is released.

Peaking/ Dipping Meter

In addition to an accurate digital display, all Fluke Voltmeters in the 8920-Series feature an analog meter for peak and null voltage adjustments. The meter indicates 0 to 100 percent full scale in each range.

Linear Analog Output

Models 8920A and 8922A are equipped with a rear panel output for driving X-Y or strip chart recorders, delivering voltages proportional to the display count. A 2-volt level equals 2000 counts, a 1-volt level equals 1000 counts, etc. This feature is not available on Model 8921A.

Accuracy

Fluke Digital Voltmeters avoid the possibilities for error so common in analog meters. The digital displays eliminate the likelihood of misreading the meter due to viewing angle problems of parallax common with analog meters. Also, the accuracy of 8920-Series Voltmeters is specified as a percent of reading rather than as percent of full scale.

Percent of reading accuracy does not degrade for measurements at the low end of a scale. Front panel switching offers a choice of readings in dB or volts.

Specifications

Technical Specifications

The accuracy specifications below apply from 9% to 100% of full scale and from 18°C to 28°C for 90 days. For six-month specifications multiply figures by 1.5.

AC Accuracy: ± % of voltage reading or ±dB (8920A/8921A)

Range	2 Hz	10 Hz	20 Hz	50 Hz	10 kHz	200 kHz	1 MHz	2 MHz	10 MHz	20 MHz
700V 200V	Not Speci-fied	5% or 0.5 dB	1% or 0.15 dB	0.5% or 0.1 dB		0.7% or 0.15 dB	Not Specified			
20V 2V 200 mV							3% or 0.35 dB		5% or 0.5 dB	
20 mV			2% or 0.245 dB	1% or 0.15 dB		2% or 0.25 dB	4% or 0.4 dB			
2 mV			3% or 0.35 dB	2% or 0.25 dB		3% or 0.35 dB				

AC Accuracy: ± % of voltage reading or ±dB (8922A)

Range	2Hz	10Hz	20Hz	50Hz	10kHz	200kHz	1MHz	2MHz	11MHz
	FILTER IN				FILTER OUT				
700V 200V	3% or* 0.35 dB 5% or 0.5 dB	1% or* 0.15dB 5% or 0.5 dB	1% or 0.15dB	0.5% or 0.1 dB		0.7% or 0.15 dB	Not Specified		
20V 2V 200 mV							3% or 0.35 dB	5% or 0.5 dB	
20 mV		2% or* 0.25 dB	2% or 0.25 dB	1% or 0.15 dB		2% or 0.25 dB			
2 mV	5% or* 0.5 dB**	5% or 0.5 dB	3% or 0.35 dB	2% or 0.25 dB	4% or 0.4 dB				

**Valid when AC + DC DAMPING is selected and input has no dc components.*

***Below 2 mV add number of digits (N) to ±5% voltage readings, where N = 5 ÷ mV input. Or, for dB readings, add N to ±0.5 dB, where N = 0.5 ÷ (mV input)^2*

AC+DC Accuracy: Add to AC accuracy specifications (above) ±10 digits or ±0.5 dB above 2 mV, or ±100 digits or ±5.0 dB below 2 mV. For dc only, add above digits to 50 Hz to 10 kHz specifications

Functions: True RMS measurements only. AC or AC + DC (8920A and 8921A); AC or AC + DC with damping (8922A)

Maximum Input: 700V rms or 1000V peak, not to exceed a volt-hertz product of 1 x 10^8 on any range

Maximum Common Mode Voltage
8920A and 8922A: 400 mV rms or 600 mV peak
8921A: 500V rms or 700V peak

AC Common Mode Rejection: ≥60 dB at 50 and 60 Hz with 100Ω unbalance

DC Common Mode Rejection: ≥100 dB, 100Ω unbalance

Crest Factor: 7 at full scale, increasing down scale by 7 times the voltage range divided by the voltage input. Degrades below 10 Hz, annunciated when capability exceeded (8922A only)

Input Impedance: 10 MΩ shunted by <30 pF

Voltage Ranges: 2 mV, 20 mV, 200 mV, 2V, 20V, 200V, 700V

Ranging: Autoranging with HOLD to defeat auto ranging and STEP UP for manual ranging. Ranges up at 2000 counts and ranges down at 180 counts

Decibel Ranges: In the autorange mode, the instrument appears as though it has a single range spanning 131 dB

dBm Reference: Twelve user-selectable impedances are provided to reference a 0 dBm, 1 mW level (50Ω, 75Ω, 93Ω, 110Ω, 124Ω, 135Ω, 150Ω, 300Ω, 600Ω, 900Ω, 1000Ω, and 1200Ω) (dBV = 1000Ω)

Relative dB Reference: A voltage input present when this button is pushed is held as "0 dB" reference point. Subsequent readings indicate ± deviations from this point

Voltage Resolution: 0.05% of ranges (3$^1/_2$ digits)

Decibel Resolution: 0.01 dB (4 digits)

Typical-3 dB Points: 40 MHz on 20 mV thru 20V ranges and 4 MHz on 2 mV range (8920A/8921A); 22 MHz on 2 mV to 20V ranges (8922A)

Low Pass Filter: Approximately 200 kHz -3 dB point, on 8922A only

Reading Rate: 2.5/s or 1/s with ac + dc with damping (8922A)

Autorange Rate: <950 ms or <3.5s with ac + dc with damping (8922A)

Response Time: (To rated accuracy) <1.6s or <7s with ac + dc with damping (8922A)

Readout: Panel-selectable for volts or dB, automatic decimal point location: analog peaking/ dipping meter

LED Annunciators: Indicate "mV," "V," "dB," "REL REF," and "2 MHz MAX" for 2 mV range (8920A and 8921A) and "UNCAL" when crest factor limitation exceeded (8922A)

Overrange: Flashes maximum reading for that range

Underrange: Flashes decimal

Linear Analog Output: (8920A and 8922A only) Linear output of 2000 mV dc for a 2000-count readout; ±1.0% relative to display; essentially 0Ω output into a ≥10 kΩ load; non-isolated, with output common same as input common

Option Specifications

Counter Output Option (-03)

Drives frequency counters. Converts input signal into a 100 mV peak square wave. Greater dynamic range extends the sensitivity of counters to 180 µV at the low end and 700V at the high end. Impedance is 50Ω. Used with the 8921A, counter can measure signals elevated to 500V rms.

Logarithmic Analog Output Option (-04)

For 8920A and 8922A only. Provides an analog output voltage proportioned to the logarithm of the input voltage. Plots logarithmically-scaled graphs, dB variations. Zero volts and zero dB on the output correspond with 200 µV on input. A 13.1V output corresponds to 700V or 131 dB on the input. Therefore, 2V on the output equals 20 dB, 6V equals 60 dB, etc., making it easy to relate voltage to dB. The option provides a low-cost way of using an X-Y recorder to plot graphs as one continuous curve over any part of the 131 dB range.

PTI Interface Option (-521)

To use the 8920-Series DVM's with Fluke's own addressable Portable Test Instrument (PTI) byte-serial data bus. Output to Fluke printers, typically. Supplied with 2-foot ribbon cable Y7203.

1120A Interface Option (-522)

A "personality card" that fits in the Fluke 1120A GPIB/IEEE-488* Translator.

IEEE-488 Interface Option (-529)

The 8920-Series Voltmeters can be made compatible with IEEE Std 488-1978 by using Option -529 in combination with the Fluke Model 1120A Translator. A single 1120A will interface three Fluke instruments to the bus. Option -529 is electrically equivalent to Option -521 plus Option -522. Supports subsets SH1, AH1, T3, TE3

*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

General Specifications

Temperature: -40°C to +75°C, non-operating
Relative Humidity: <80%
Shock: MIL-T-28800 all classes
Vibration: MIL-T-28800, classes 2, 3 & 4
MTBF: >10,000 hours
Power: 100V, 120V, 220V ac ±10% or 240V ac +4%, -10%, selected by internal switches, 50 to 400 Hz, 10W max
Size: 32.6 cm L x 20.3 cm W x 10.5 cm H (12.9 in L x 8.0 in W x 4.3 in H)
Weight: 2.47 kg (5.44 lb)
Included: Manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

8920A	DVM, BNC Input, 10 Hz-20 MHz	$1995
8921A	DVM, Banana Jack Input, 10 Hz-20 MHz	1995
8922A	DVM, BNC Input, 2 Hz-11 MHz	2095

Options (for above Models)

-03	Counter Output	250
-04*	Logarithmic Output (not for 8921A)	220
-521	PTI Interface	205
-521K	PTI Interface field-installable	220
-522K	1120A Interface field-installable	135
-529**	IEEE-488 Interface	300

*Not compatible with -521, -521K, -529

**The -529 Option can be ordered and installed at time of manufacture only. For existing instruments which do not have -529 Option installed, an IEEE Interface can be added by ordering -521K and -522K (1120A required).*

Accessories (Also see page 127)

1120A	IEEE-488 Translator	$590
Y7203	2 ft PTI Ribbon Cable	55
Y7204	5 ft PTI Ribbon Cable	70
Y2014	5¼" Rack Adapter, Single	95
Y2015	5¼" Rack Adapter, Dual	95
Y2020	Panel Mount Kit	95
Y2024	3-Module Power Cord	21
A90	6-Range Current Shunt	700
80J-10	10 Amp Current Shunt	35
Y9100	BNC 50Ω Attenuator (6 dB)	55
Y9101	BNC 50Ω Attenuator (14 dB)	55
Y9102	BNC 50Ω Attenuator (20 dB)	55
Y9103	50 Ohm Feedthrough Terminator	35
Y9107	BNC "T"	15
Y9109	Banana to BNC Adapter	20
Y9111	3-foot BNC to BNC Cable	20
Y9112	6-foot BNC to BNC Cable	20

Service & Support

Warranty

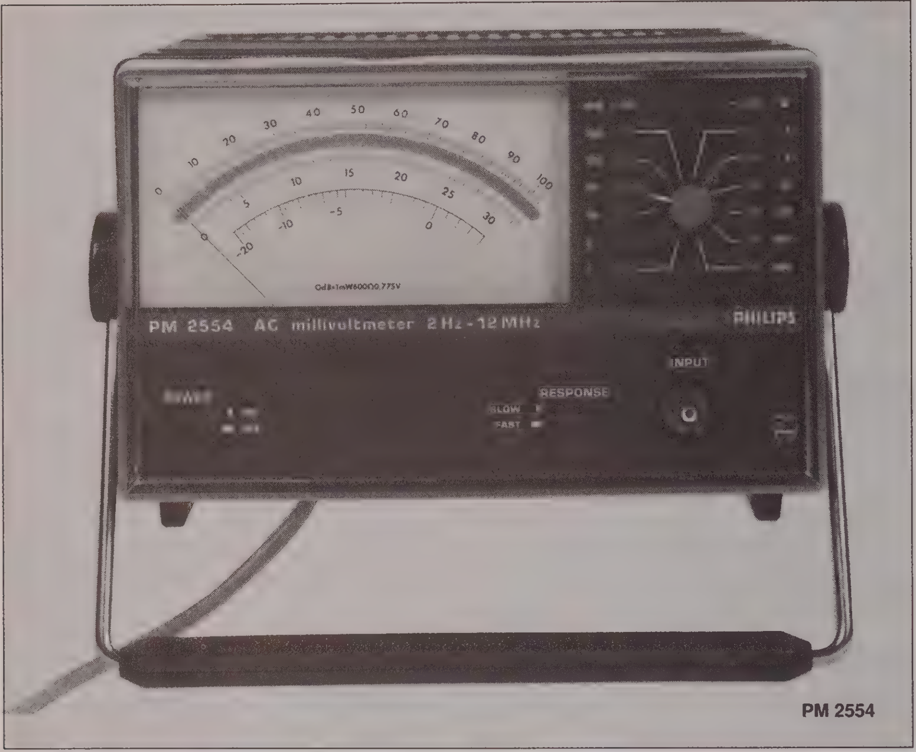
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-8920A	Repair (w/ calibration)	180
SC1-8920A	Repair (cal w/ in or out data)	215
SC1-8920A	Repair (cal w/ in and out data)	250
SC2-8920A	Cal (4/yr recommended)	252
SC2-8920A	Cal (4/yr w/ in or out data)	392
SC2-8920A	Cal (4/yr w/ in and out data)	532
SC1-8921A	Repair (w/ calibration)	180
SC1-8921A	Repair (cal w/ in or out data)	215
SC1-8921A	Repair (cal w/ in and out data)	250
SC2-8921A	Cal (4/yr recommended)	252
SC2-8921A	Cal (4/yr w/ in or out data)	392
SC2-8921A	Cal (4/yr w/ in and out data)	532
SC1-8922A	Repair (w/ calibration)	193
SC1-8922A	Repair (cal w/ in or out data)	228
SC1-8922A	Repair (cal w/ in and out data)	263
SC2-8922A	Cal (4/yr recommended)	252
SC2-8922A	Cal (4/yr w/ in or out data)	392
SC2-9822A	Cal (4/yr w/ in and out data)	532

AC Millivoltmeter

PM 2554

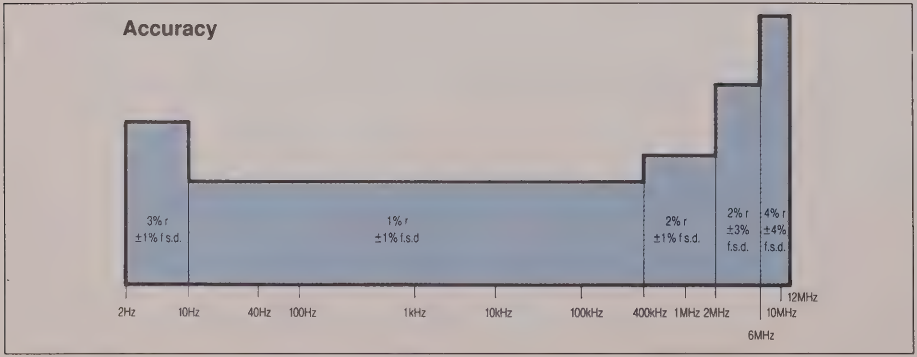


PM 2554

PM 2554 Wide Bandwidth AC Millivoltmeter

- Sensitivity 1 mV (fsd) to 300V
- Bandwidth 2 Hz...12 MHz
- High accuracy up to 1% fsd ±1% of reading
- 140 dB CMRR at 50 Hz (1 mV range)
- DC recorder output or AC output

The PM 2554 combines good accuracy with an extremely wide bandwidth (12 MHz) and voltage range (100 µV-300V). It is therefore ideal for all measurements from audio frequencies to HF and beyond. All ranges are protected from overloads of up to 300 VRMS (400 V_{DC}). Power Line voltage variations of ±10% give no more than 0.1% change in accuracy.



Specifications

Measuring Ranges: 0-300 V_{RMS} in 12 ranges from 0-1 mV to 0-300V. dB scale ranging from -80 dB to +52 dB (0 dB - 1 mV into 600Ω)
Frequency Range: 2 Hz-12 MHz
Input: Floating
Input Impedance: 1 MΩ//33 pF
Max. Voltage Low-Ground: 1 GΩ/1.4 nF
For reduction of capacitive loading, the PM 2554 can be used with the PM 8926 oscilloscope probe, input impedance 10 MΩ//11 pF
Common Mode Rejection: 140 dB at 1 kHz in 1 mV range; 120 dB at 100 kHz in 1 mV range
Accuracy: 1% fsd. + 1% of reading
Additional error for frequencies outside flat part of bandwidth - see graph
Stability: A line voltage variation of ±10% will give an additional error of 0.1% max.
Long-Term Stability: ±0.1% over 90 days
Noise At Short-Circuited Input: <30 µV
Influence of noise on measuring accuracy less than 0.5% at 10% of full scale deflection
Overload: Protected against overloads up to 300 V_{RMS} or 400 V_{DC}

Recorder Output
DC Voltage: 1V at full scale
Output Impedance: 1 kΩ
Accuracy: As specified for voltmeter

AC Output
Output Impedance: 600Ω in series with 47 µF
Output Voltage: 50 mV; Short-circuit proof
Line Voltages: 90V...132V or180V...265V; 50/60 Hz

Temperature Range
Reference Temp.: 23°C ±5°C
Operating Temperature: 0°C...45°C
Temperature Coefficient: 0.1%/°C
Size: 236 mm W x 145 mm H x 298 mm L (9.3 in. W x 5.7 in. H x 11.7 in. L)
Weight: 3.5 kg (7.7 lb)
Included: Line cable, measuring cable, instruction manual

Ordering Information

Models

January 1989 prices

PM 2554/013 Millivoltmeter	$1460

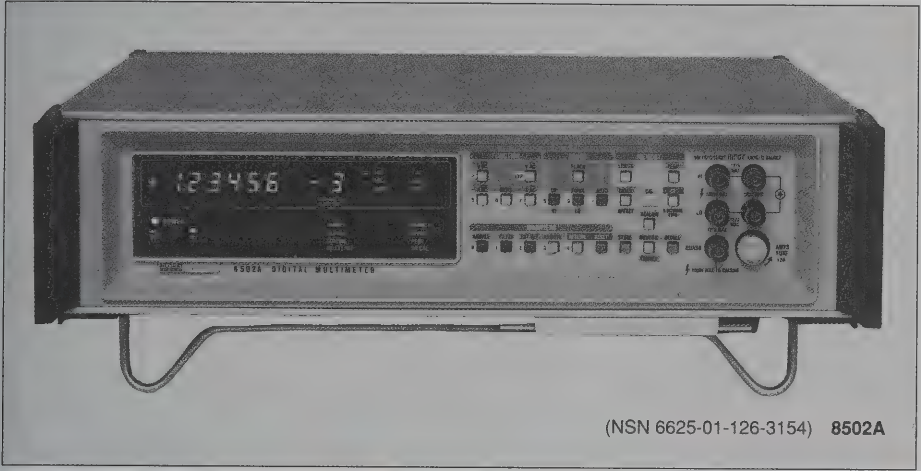
Accessories (Also see page 127)

PM 9072 Measuring Cable Banana-BNC, 135Ω	28
PM 8924/00 Passive Probe 1:1	60
PM 8926 Passive Probe 10:1	70
PM 9051 Adapter BNC-Banana	9

Note: The above configurations meet North American power requirements. For other power options, see page 491.

8502A Limited Availability

GPIB IEEE-488


(NSN 6625-01-126-3154) **8502A**

8502A Digital Multimeter
6 ppm dc accuracy
6-1/2 digit resolution
500 readings per second system speed
Modular construction for configurability
Interface options: GPIB/IEEE-488,* RS-232-C, or Parallel
Measurement options: AC volts, true-rms or averaging; Resistance; Current
Up to 212% overrange

Note: In most applications, the 8505A or 8506A DMMs should be substituted.

Ordering Information

Model	January 1989 prices
8502A Digital Multimeter	$5650

Options (for (8502A)

-**01** Average Responding AC Converter	650
-**02** Ohms Converter	850
-**03** Current Converter	550
-**04** Cal Memory	550
-**05** IEEE-488 Interface	550
-**06** RS-232-C Interface	550
-**07A** True Parallel Interface (for DEC PDP11, DR11C, DRV11)	550
-**09A** RMS AC Converter	735
-**16** Switchable Front/Rear Inputs	550

* *All options except -16 are customer installable*

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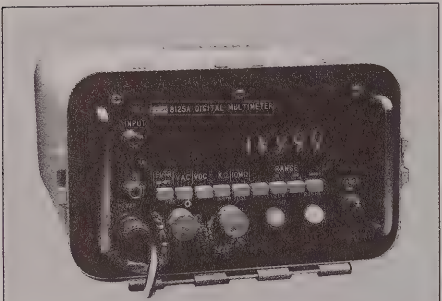
* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Limited Availability

Digital Multimeter 8125A & 8425A



(NSN 6625-00-482-1496) **8125A**

Model 8125A is a compact, militarized 5-1/2 digit digital multimeter designed to meet MIL-T-28800B, Type II, Class 2, Style A requirements for rugged field applications. Prices on request.

Model 8425A is a ruggedized 5-1/2 digit rack mounted digital multimeter, designed for system applications, that meets the requirements of MIL-T-28800B, Type II Class 4, Style B.

The functions, ranges, and performance of the 8425A are identical to those of the discontinued 8400A. Prices on request.

Digital Voltmeters

(NSN 6625-00-451-9287) **887AB**

Fluke Differential Voltmeters, at one time, were the most accurate kind of voltmeters available. They are still exceptionally accurate but their principal remaining advantage is their extremely high input impedance for dc "at null," a setting where input voltage is most accurately measured. When measuring voltage from relatively high impedance sources, the input impedance of any voltmeter acts as a load and has a very significant effect on the accuracy of the measurement. Differential voltmeters reduce the measurement error in such cases.

Because analog meters are used on the front panel of differential voltmeters to indicate a null condition, they also provide a good visual monitor of small voltage changes and trends.

Differential Voltmeter Selection Guide

Model	DC Resolution	AC Sensing	Infinite Impedance
893A	10 µV	Average	To 1100V
895A	1 µV	N/A	To 1100V
887AB	1 µV	Average	To 11V
931B-01	N/A	True RMS	N/A

893A Differential Voltmeter	$5250
895A Differential Voltmeter	6295
887AB Differential Voltmeter	7350
931B-01 Differential Voltmeter	5590

A-90 Current Shunt

The model A-90 Current Shunt may be used for both ac and dc current measurements over six current ranges from 0.1 mA range to 10A range. A voltage of 100 mV, measurable with virtually any voltmeter, is developed at full scale on each range. Basic accuracy is ±0.15% for dc, ±0.3% for ac.

A-90 Current Shunt	700

80E-10 High Voltage Divider

The 80E-10 is a voltage divider designed for use with voltmeters in measuring up to 10,000V dc. Divider outputs at 10V and 1V are proportional to 10 kV dc input and are accurate to ±0.01%. High measurement stability and accuracy are assured through the use of Fluke manufactured precision wire-wound resistors mounted on glass-epoxy printed circuit boards.

80E-10 High Voltage Divider	1325

Handheld Multimeters

Page 103 Fluke 77

Page 110 Fluke 87

Page 108 Fluke 27

Page 119 Fluke 8060A

Fluke and Philips handheld digital multimeters (DMMs) all operate from small, self-contained batteries. Some can also be operated from ac power using a battery eliminator.

Many Fluke and Philips handheld DMMs rival the performance of more expensive bench models. Others have features that make them uniquely suited for particular applications for industries. For example, the Fluke Model 25 and 27 are sealed against rain and moisture and can be used at temperatures well below freezing. The Fluke Model 87 can capture the value of high momentary motor-starting currents. The Philips PM 2618/323 mAs meter is ideally suited for medical x-ray applications. The Fluke 8060A and Fluke 87 can read the frequency of telephone touchtone signals and display ac voltages as decibel levels with respect to 1 milliwatt.

All Fluke and Philips handheld multimeters are designed to take electrical and physical abuse with little or no damage.

Selection Guide 102

Handheld Multimeters 103

Handheld Multimeters Selection Guide

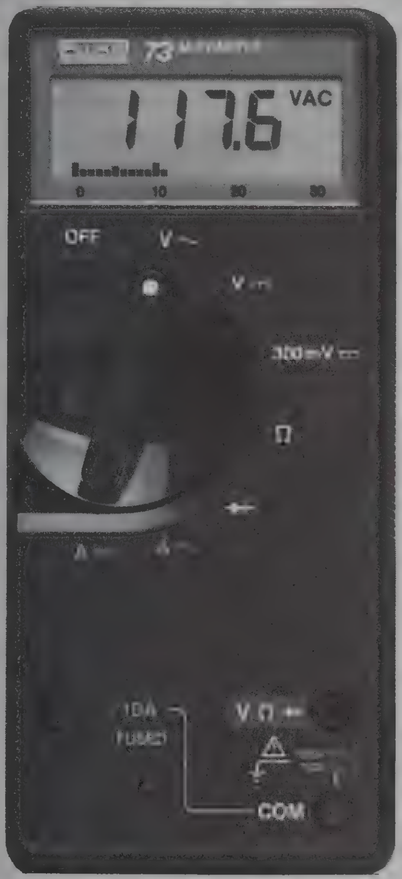
	Basic Features		Special Features												DC Volts**		AC Volts					AC/DC Amps		Ohms, etc.				
Models	Max Display Counts*	Autoranging	Analog Bar Graph	Frequency Measurement	dB, dBm Readout	Offset/Relative Ref	Continuity & Beeper	Peak-Hold, AC/DC	Touch-Hold	Sealed Case Water/Chemical Resistant	Min/Max Hold	Milliamp Seconds (mAs)	Capacitance 5.00 nF to 5.00 µF	Duty Cycle 0.0 to 99.9%	Basic Accuracy, %	Max Resolution, µV	Max AC Voltage, w/o Probe (RMS)	True-RMS	Basic Accuracy, %	Max Resoltuion, µV	Frequency Range, Hz	Max Resolution, µA	Max Amps, w/o Probe	Max Resolution, mΩ	Max Resistance, MΩ	Diode test	Conductance (Low) > 20 MΩ	Page
Fluke 73	3200	•	•	—	—	—	—	—	—	—	—	—	—	—	0.7	100	750	—	3.0	1k	1k	10k	10	100	32	•	—	103
Fluke 75	3200	(1)	•	—	—	—	•	—	—	—	—	—	—	—	0.5	100	750	—	2.0	1k	1k	10k	10	100	32	•	—	103
Fluke 77	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.3	100	750	—	2.0	1k	1k	10k	10	100	32	•	—	103
Fluke 21	3200	(1)	•	—	—	—	•	—	—	—	—	—	—	—	0.5	100	750	—	2.0	1k	1k	10k	0.32	100	32	•	—	106
Fluke 23	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.3	100	750	—	2.0	1k	1k	10k	10	100	32	•	—	106
Fluke 25	3200	(1)	•	—	—	—	•	—	•	•	—	—	—	—	0.1	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	108
Fluke 27	3200	(1)	•	—	—	•	•	—	•	•	•	—	—	—	0.1	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	108
Fluke 83	4000	(1)	•	•	—	•	•	—	•	(6)	(7)	—	•	•	0.3	100	1000	—	1.0	100	5k	0.1	10	100	40	•	•	110
Fluke 85	4000	(1)	•	•	—	•	•	—	•	(6)	(7)	—	•	•	0.1	100	1000	—	0.5	100	20k	0.1	10	100	40	•	•	110
Fluke 87	4000	(1)	(5)	•	—	•	•	•	•	(6)	(7)	—	•	•	0.1	100	1000	•	0.5	100	20k	0.1	10	100	40	•	•	110
8025B	3200	(1)	•	—	—	•	•	—	•	•	•	—	—	—	0.2	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	127
8024B	2000	—	—	—	—	—	•	•	(2)	—	—	—	—	—	0.1	100	750	—	0.75	100	5k	1	2	100	20	•	•	115
8026B	2000	—	—	—	—	—	•	—	—	—	—	—	—	—	0.1	100	750	•	0.5	100	10k	1	2	100	20	•	•	115
8020B	2000	—	—	—	—	—	•	—	—	—	—	—	—	—	0.1	100	750	—	0.75	100	5k	1	2	100	20	•	•	115
8021B	2000	—	—	—	—	—	•	—	—	—	—	—	—	—	0.1	100	750	—	1.0	100	450	1	2	100	20	•	—	115
8060A	20,000	—	—	•	•	•	•	—	—	—	—	—	—	—	0.04	10	750	•	0.2	10	100k	0.01	2	10	300	•	•	119
8062A	20,000	—	—	—	—	•	•	—	—	—	—	—	—	—	0.05	10	750	•	0.5	10	30k	0.01	2	10	300	•	—	119
PM 2518	2K/11K	(1)	•	—	•	•	•	—	—	—	—	—	—	—	0.1	100	750	(3)	0.5	100	40k	10	10	100	100	•	—	123
PM 2618	2K/11K	(1)	•	•	•	•	•	—	—	—	—	(4)	—	—	0.07	100	750	(3)	0.4	100	70k	10	10	100	100	•	—	123
PM 2718	2K/11K	(1)	•	•	•	•	•	—	•	—	(7)	—	—	—	0.04	100	750	(3)	0.3	100	100k	10	10	100	100	•	—	123

•	*Standard*	*(1) Or manual ranging*	*(4) For PM 2618/323*
—	*Not applicable*	*(2) Use Peak-Hold Mode*	*(5) Analog Pointer*
*	*All displays LCD*	*(3) AC Coupled*	*(6) Splash and dust proof*
**	*Max DC Voltage w/o Probe 1000V*		*(7) MINMAX Average*

For Bench/System Multimeters see page 59.
For Multimeter Accessories see page 127.

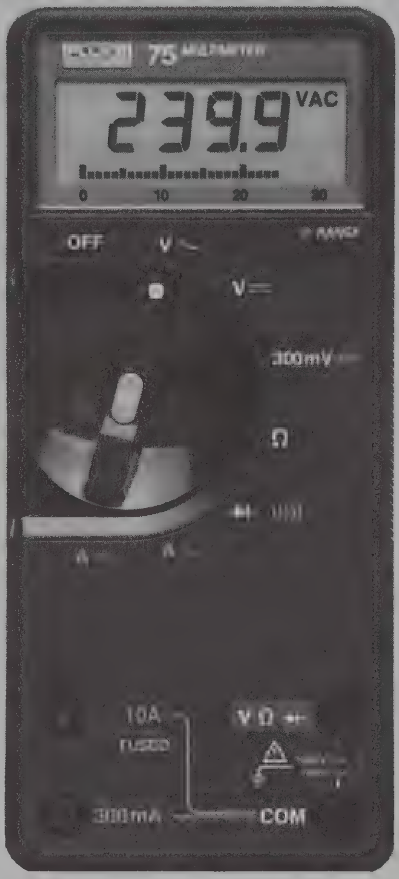
Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

73, 75 & 77



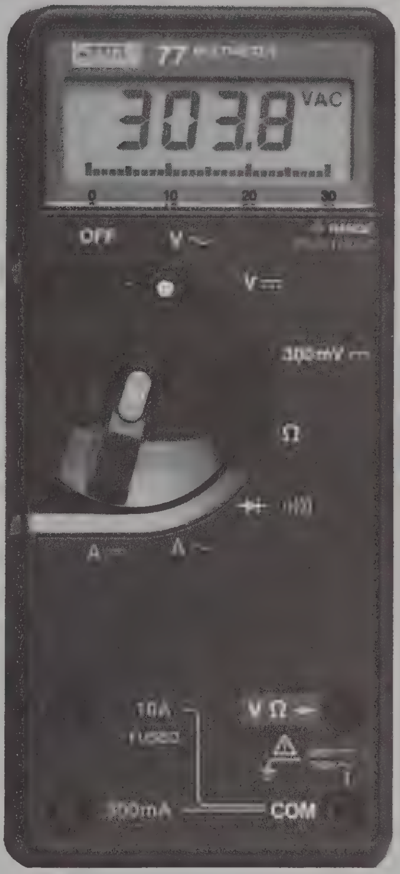
LISTED
UL
1244

Fluke 73



LISTED
UL
1244

Fluke 75



LISTED
UL
1244

Fluke 77

Fluke 73 Multimeter
3-1/2 digit, 3200 count display
31 segment analog bar graph
0.7% basic dc accuracy
Single rotary switch control
Autoranging selection
2000 hour battery life
"Sleep Mode" extends battery life
One current range: 10A
3 year warranty, 1-year calibration cycle
Inputs overload protected and10A fused

Fluke 75 Multimeter
3-1/2 digit, 3200 count display
31 segment analog bar graph
0.5% basic dc accuracy
Single rotary switch control
Autoranging & manual selection
2000 hour battery life
"Sleep Mode" extends battery life
3 current ranges: 10A, 320 mA & 32 mA
3 year warranty, 1-year calibration cycle
Inputs overload protected and 10A fused
Continuity beeper

Fluke 77 Multimeter
3-1/2 digit, 3200 count display
31 segment analog bar graph
0.3% basic dc accuracy
Single rotary switch control
Autoranging and manual selection
2000 hour battery life
"Sleep Mode" extends battery life
3 current ranges: 10A, 320 mA & 32 mA
3 year warranty, 1-year calibration cycle
Inputs overload protected and 10A fused
Touch Hold® to capture readings
Multipurpose protective holster
Continuity beeper

73, 75 & 77

These digital multimeters with analog bar graph display utilize the latest advances in microcircuit technology without compromising quality or capability. The result is a series of meters with features never before found, not even on expensive instruments.

Digital/Analog

The Model 73, 75, and 77 provide a 3200 count digital display that gives extended resolution and a 31 segment bar graph that reacts 10 times faster than the numerical display, allowing you to make peaking and dipping adjustments easier than with digital-only DMMs.

Autoranging

With autoranging, you choose the function you want and the meter automatically selects the range with the greatest accuracy and resolution. Symbols on the liquid crystal display remind you what is being measured and the range of measurement.

Range Hold (75, 77)

Since repetitive go-no-go tests and peaking/dipping adjustments are more easily done using one range, the manual range function will prove a real boon to users making these tests frequently. Touching the pushbutton once prevents the meter from changing ranges. Pushing the button again changes the range, and holding the button down for a couple of seconds restores the "Autorange" function.

Audible Tones (75, 77)

A continuous audible tone provides a fast check for continuity of current paths having 150 ohms or less. A brief tone indicates a voltage drop of about 0.6 volts, the normal forward bias for semiconductor devices passing about 500 microamps.

Touch Hold® (77)

Touch Hold® captures a reading and displays it from memory even after the probe has been removed from the circuit. As soon as the reading stabilizes, the meter makes a distinctive audible chirp and automatically holds the reading. Touch Hold® reduces the chance of circuit damage when a probe slips and contacts two points at once because you can concentrate on touching the right test point and nothing else. Touch Hold® reduces the risk of electrical shock and also gives the user time to log the reading if needed or refer back to the reading before the next measurement.

Multipurpose Holster (77)

Our multipurpose holster is made of a tough resilient plastic that snaps over the instrument, protecting it from even the most severe shock. Both test leads may be snapped into the holster in a position so only one hand is needed to hold both the meter and probe tip in contact with the test point. You can also hang the meter on your belt or for easy viewing while probing, tilt it back on its bail for bench use.

Specifications

Technical Specifications

Accuracy specifications apply for 1 year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90% (80% for 32Ω resistance range) unless otherwise noted.

DC Voltage

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
320 mV	0.1 mV	0.7%+1	0.5%+1	0.3%+1
3.2V	1 mV			
32V	10 mV			
320V	100mV			
1000V	1V	0.8%+1	0.6%+1	0.4%+1

Input Resistance: 10 MΩ
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥ 120 dB for dc, 50 Hz, and 60 Hz
Overload Protection: 500V dc or rms ac for 320 mV range and 1000V dc or 750V rms ac for other ranges
Response Time: ≤1 second to rated accuracy

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
3.2V	1 mV	3%+2*	2%+2*	2%+2*
32V	10 mV	3%+2**	2%+2**	2%+2**
320V	100 mV			
750V	1V			

** 45 Hz to 500 Hz*
***45 Hz to 1 kHz*
Typical frequency response is -0.5 dB at 10 kHz on the 32V and 320V ranges and ±3 dB at 5 kHz on the 3.2V and 750V range.

Input Impedance: 10 MΩ and ≤50 pF on all ranges
Common Mode Noise Rejection: ≥60 dB dc to 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc, 750V rms ac
Response Time: ≤ 2 seconds to rated accuracy

DC Current

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
32 mA	0.01 mA	–	1.5%+2	1.5%+2
320 mA	0.1 mA	–	2%+2	2%+2
10A	10 mA	2%+2	1.5%+2	1.5%+2

Voltage Burden: 0.2V on 32 mA range, 2.0V max. on 320 mA range, 0.5V on 10A range
Input Protection: 630 mA/250V fuse in series with 0.36Ω fusible resistor for 300 mA input; 15A/600V fuse on 10A input
Response Time: ≤1 second to rated accuracy

AC Current (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
32 mA	0.01 mA	–	3%+2*	3%+2*
320 mA	0.1 mA	–		
10A	10 mA	3%+2*		

** 45 Hz to 1 kHz*

Voltage Burden: 0.2V on 32 mA range, 2.0V on 320 mA range, 0.5V on 10A range
Input Protection: 0.63A/250V fuse in series with 0.36Ω fusible resistor for 300 mA input; 15A/600V fuse on 10A input
Response Time: ≤2 seconds to rated accuracy

Resistance

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
320Ω	0.1Ω	1%+2	0.7%+2	0.5%+2
3200Ω	1Ω	0.7%+1	0.5%+2	
320kΩ	10Ω1%+1			
320 kΩ	100Ω			
3.2 MΩ	10 kΩ	3%+1	2.5%+1	2.0%+1

Open Circuit Voltage: ≤3V Full Scale Voltage: ≤440 mV on all ranges except ≤1.4V on 32 MΩ range
Input Protection: 500V dc or rms ac
Response Time: ≤10s up to 32 MΩ to rated accuracy

Continuity

Threshold: Approximately 150 ohms
Audible Tone: Continuous tone for continuity. Fluke 75 and 77 only.
Display: Less than .100 indicates continuity, OL (overload) indicates open-circuit, approximately 20,000 ohms or higher.
Response Time: Approximately 100 ms

Diode Test

Test Current: Approximately 500 µA for a normal forward biased diode
Audible Tone: Brief tone for normal forward biased diode or semiconductor junction. Fluke 75 and 77 only.
Display: An indication of approximately .600V for a normal forward biased silicon diode or semiconductor function and OL (overload) for a normal reverse biased diode or semiconductor junction
Response Time: Approximately 100 ms

Analog Display

Measurement Rate: 23 measurements per second

Touch-Hold®

Fluke 77 only. Pushbutton activated mode. Automatically holds stable reading of voltage, resistance, or current indefinately even if test probe is removed. Reading updated by touching probe to other test points.

General Specifications

Max Common Mode Voltage: 1000V dc or peak ac
Temperature: 0°C to 50°C operating; -40°C to 60° C non-operating
Temperature Coefficient: 0.1 x specified accuracy per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C, ≤90% to 35° C except ≤80% using 32 MΩ range
Safety: Protecton Class II per IEC 348, UL 1244 listed and VDE 0411 licensed
Power: Single 9V battery, NEDA 1604 9V
Battery Life: More than 2000 hours (alkaline) or 1600 hours (carbon-zinc). "Sleep Mode" extends battery life when you forget to turn power off (15 min in diode test)
Size: 166 mm L x 75 mm W x 28 mm H(6.55 in x 2.95 in x 1.12 in)
Weight: 0.28 kg (0.63 lb)
Included: TL70 Test Leads, manual, plus battery and spare fuse (installed). Also C70 Holster included with Fluke 77

Ordering Information

Models

January 1989 prices

Fluke 73 DMM w/3-year warranty	$79
Fluke 75 DMM w/beeper, w/3-year warranty	119
Fluke 77 DMM w/Touch-Hold, w/beeper, w/3-year warranty	159

**Includes C70 Multipurpose Holster*

Accessories (Also see page 127)

TL20 Test Lead Set	35
TL70 Replacement Test Leads	8
Y8134 Deluxe Test Lead Kit	22
Y8140 Test Lead Set	20
C50 Soft Carrying Case	15
C70 Multipurpose Holster	14
C100 Universal Carrying Case	30
83RF RF Probe	55
85RF RF Probe	85
80TK Thermocouple Probe	65
80T-150U Temperature Probe	120
80K-6 High Voltage Probe	49
80K-40 High Voltage Probe	85
Y8100 DC/AC Current Probe	259
Y8101* AC Current Probe	69
80i-400* AC Current Probe	69
80i-410* DC/AC Current Probe	129
80i-600* AC Current Probe	119
80i-1010 DC/AC Current Probe	229
LCA-10 Line Current Test Adapter	13

**Not applicable to Fluke 73*

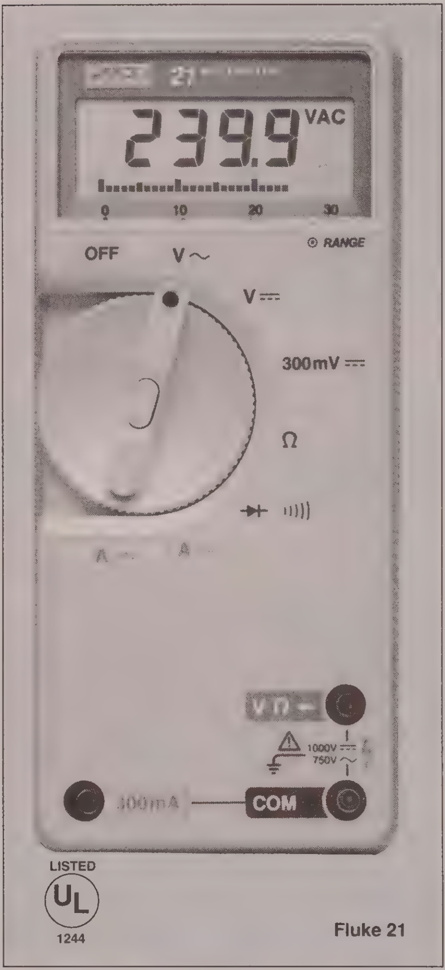
Service & Support

Warranty

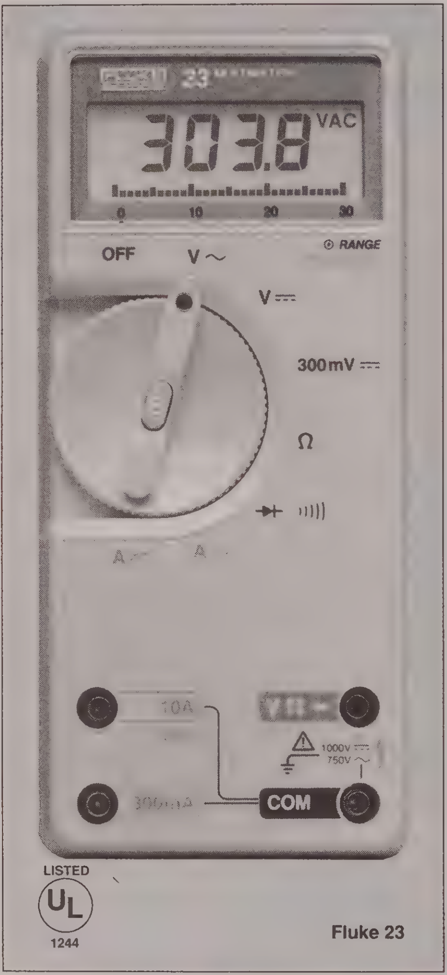
Three-year product warranty. See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)

21 & 23



Fluke 21



Fluke 23

Fluke 21 & 23 Low-Cost, High-Accuracy Multimeters

- Analog and digital display - tests changing or stable signals
- Easy to use - single rotary switch and automatic ranging
- Volts, ohms, diode test, milliamps, 10 amps (Fluke 23)
- All inputs overload protected, including 10 amps
- 3-year warranty, 1-year calibration cycle
- High visibility yellow, high impact ABS case
- Touch-Hold® (Fluke 23)
- 2000 hour battery life on a single 9V battery

Safety Designed

All inputs on the Fluke 21 and 23 are protected from high energy overloads, including the Fluke 23's fused 10 amp range. Resistance, continuity and mV functions are overload protected to 500V dc or ac rms, voltage functions to 1000V dc and 750V ac rms. Recessed input jacks accept Fluke safety designed test leads or standard banana plugs.

3200 Count Digital Display

Offers better accuracy and resolution than a conventional 3 1/2 digit (1999 count) DMM. High contrast liquid crystal display, with wide viewing angle, updates two times per second.

31-Segment Analog Bar Graph

Makes dynamic measurements such as peaking, nulling, zero adjustments and capacitor checking. Updates ten times faster than digital readout.

Fast Autoranging and Automatic Polarity

Simplifies and speeds up the use of the meter by instantly selecting the proper range. Optional manual ranging included. Reverse polarity is indicated by a "-" sign next to the reading.

Touch-Hold® (Fluke 23)

Allows automatic measurements while watching probes and circuit. The meter captures the measurement, beeps, and locks it in the display until you're ready to view it. Automatically updates with each new stable measurement value.

Audible Continuity/Diode Test

Wiring, diode and transistor checks can be done quickly without looking at the display. A continuous tone signals continuity, a beep signals a forward biased diode or transistor.

Standard Equipment

Every meter is packaged with a pair of safety designed Fluke TL70 right angle test leads, two insulated alligator clips, 9V battery installed, spare fuse and operator's manual. Fluke 23 comes with C70 protective holster that includes tilt bail, belt hook and lead storage. C70 is available as an accessory for Fluke 21.

Specifications

Technical Specifications

Accuracy specifications apply for 1 year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90% (80% for 32 MΩ resistance range) unless otherwise noted.

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
320 mV 3.2V 32V 320V	0.1 mV 1 mV 10 mV 100 mV	0.5% + 1	0.3% + 1
1000V	1V	0.6% + 1	0.4% + 1

Input Resistance: 10MΩ
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB for dc 50 Hz and 60 Hz
Overload Protection: 500V dc or rms ac for 320 mV range and 1000V dc or 750V rms ac for other ranges

Response Time:≤1 second to rated accuracy

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
3.2V	1 mV	2% + 2*	2% + 2*
32V	10 mV	2% + 2**	2% + 2**
320V	100 mV		
750V	1V		

** 45 Hz to 500 Hz   **45 Hz to 1 kHz*

Typical frequency response is -0.5dB at 10 kHz on the 32V and 320V ranges and ±3dB at 5 kHz on the 3.2V and 750V range.

Input Impedance: 10 MΩ and ≤50 pF on all ranges
Common Mode Noise Rejection: ≥60 dB dc to 60 Hz, 1kΩ unbalance
Overload Protection: 1000V dc, 750V rms ac
Response Time: ≤2 seconds to rated accuracy

DC Current

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
32 mA	0.01 mA	1.5% + 2	1.5% + 2
320 mA	0.1 mA	2% + 2	2% + 2
10A	10 mA	—	1.5% + 2

Voltage Burden: 0.2V on 32 mA range, 2.0V max. on 320 mA range, 0.5V on 10A range
Input Protection: Fluke 21, 630 mA/250V fuse in series with 3A/600V fuse in 300 mA input; Fluke 23, 630 mA/250V fuse in series 0.36Ω fusible resistor for mA input; 15A/600V fuse for 10A input
Response Time: ≤1 second to rated accuracy

AC Current (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
32 mA	0.01 mA	3% + 2*	3% + 2*
320 mA			
10A	10 mA	-	1.5% + 2*

**45 Hz to 1 kHz*

Voltage Burden: 0.2V on 32 mA range, 2.0V max on 320 mA range, 0.5V on 10A range
Input Protection: Fluke 21, 630 mA/250V fuse in series with 3A/600V fuse in 300 mA input; Fluke 23, 630 mA/250V fuse in series 0.36Ω fusible resistor for mA input; 15A/600V fuse for 10A input
Response Time: ≤2 seconds to rated accuracy

Resistance

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
320Ω	0.1Ω	0.7% + 2	0.5% + 2
3200Ω	1Ω	0.7% + 1	0.5% + 1
32 kΩ	10Ω		
320 kΩ	100Ω		
3.2 MΩ	1 kΩ		
32 MΩ	10 kΩ	2.5% + 1	2.0% + 1

Open Circuit Voltage: ≤3V
Full Scale Voltage: ≤440 mV on all ranges except ≤1.4V on 32 MΩ range
Input Protection: 500V dc or rms ac
Response Time: ≤1s up to 320 kΩ, ≤2s up to 3.2 MΩ, ≤10s up to 32 MΩ to rated accuracy

Continuity

Threshold: Approximately 150 ohms
Audible Tone: Continuous tone for continuity
Display: Less than .100 indicates continuity, OL (overload) indicates open-circuit, approximately 20,000 ohms or higher
Response Time: Approximately 100 ms

Diode Test

Test Current: Approximately 500 µA for a normal forward biased diode
Audible Tone: Brief tone for normal forward biased diode or semiconductor junction
Display: An indication of approximately .600 V for a normal forward biased silicon diode or semiconductor function and OL (overload) for a normal reverse biased diode or semiconductor junction
Response Time: Approximately 100ms

Analog Display

Measurement Rate: 23 measurements per second

Touch-Hold®

Fluke 23 only. Pushbutton activated mode. Automatically holds stable reading of voltage, resistance, or current indefinately even if test probe is removed. Reading updated by touching probe to other test points.

General Specifications

Max Common Mode Voltage: 1000V dc or peak ac
Temperature: 0°C to 50°C operating; -40°C to 60°C non-operating
Temperature Coefficient: 0.1 x specified accuracy per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C, ≤90% to 35°C except ≤80% using 32 MΩ range

Safety: Protection Class II per IEC 348, UL 1244 listed
Power: Single 9V battery, NEDA 1604 9V
Battery Life: More than 2000 hours (alkaline) or 1600 hours (carbon-zinc). "Sleep Mode" extends battery life when you forget to turn power off. Sleep mode activates after approximately 1 hour (5 min in diode test)
Size: 166 mm L x 75 mm W x 28 mm H (6.55 in x 2.95 in x 1.12 in)
Weight: 0.28 kg (0.63 lb)
Included: TL 70 Test Leads, manual, battery,, spare fuse (installed), and alligator clips.

Ordering Information

Models

January 1989 prices

Fluke 21 DMM w/ beeper, w/ 3-year warranty	$119
Fluke 23* DMM w/ Touch-Hold, w/ 3-year warranty	159

** Includes C70 Multipurpose Holster*

Accessories (Also see page 127)

TL20 Test Lead Set	35
TL70 Replacement Test Leads	8
Y8134 Deluxe Test and Lead Kit	22
Y8140 Test Lead Set	20
C50 Soft Carrying Case	15
C70 Multipurpose Holster	14
C100 Universal Carrying Case	30
83RF 100 MHz RF Probe	55
85RF 500 MHz RF.Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400* AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600* AC Current Probe	119
80i-1010 DC/AC Current Probe	229
LCA-10** Line Current Test Adapter	13

** LImited to ≤320A with Fluke 21*
***Fluke 23 Only*

Service & Support

Warranty

Three-year product warranty.See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)

25 & 27

LISTED
UL
1244

Fluke 25

MSHA
APPROVAL
2G-3665-0
PERMISSIBLE
MULTIMETER

LISTED
UL
1244

Fluke 27

MSHA
APPROVAL
2G-3665-0
PERMISSIBLE
MULTIMETER

Fluke 25 & 27 Analog/Digital & Rugged Multimeters

- Analog and digital display - tests changing or stable signals
- Easy to use, auto or manual range selection
- 2 year warranty
- Rugged “O” ring sealed case withstands harsh environments
- Superior EMI shielding
- -15° to 55°C operating range
- “Min-Max” Mode stores highest & lowest readings (27 only)
- “Relative Mode” displays only changes in readings (27 only)

Rugged

Plant maintenance electricians, field service technicians, electrical equipment installers, and outside equipment installers will find these instruments rugged, reliable, and easy to use while providing all the accuracy and features needed for almost any application.

Designed to meet military specification of MIL-STD-28800 for Style A, Class 2 Instruments, the Fluke 25 and 27 Analog/Digital Multimeters perform under the extremes of heat, cold, humidity, shock, electromagnetic interference, vibration, and downright abuse.

The Fluke 25 and 27 are built with cases twice as thick as any other DMM we build. The cases are waterproof to 3 feet of water for one hour, resist many industrial chemicals, and won't sustain a flame when put to the blow torch test.

Safety Protection

Electrical and safety protection exceeds the world's toughest safety standards.

Autoranging

With autoranging, you choose the function you want and the meter automatically selects the range with the greatest accuracy and resolution. Symbols on the liquid crystal display remind you what is being measured and the range of measurement.

Manual Range

Since repetitive go-no-go tests and peaking/dipping adjustments are more easily done using one range, the manual range function will prove a real boon to users making these tests frequently. Touching the pushbutton once prevents the meter from changing ranges. Pushing the button again changes the range, and holding the button down for a couple of seconds restores the “Autorange” function.

Audible Tones

A continuous audible tone provides a fast check for continuity of current paths having 150 ohms or less.

A brief tone indicates a voltage drop of about 0.6 volts, the normal forward bias for semiconductor devices.

Touch Hold®

Touch Hold® captures a reading and displays it from memory even after the probe has been removed from the circuit. As soon as the reading stabilizes, the meter makes a distinctive audible chirp and holds the reading. Touch Hold® reduces the chance of circuit damage when a probe slips and contacts two points at once because you can concentrate on touching the right test point and nothing else. Touch Hold® reduces the risk of electrical shock and also gives the user time to log the reading if needed or refer back to the reading before the next measurement.

Min/Max Mode

The 27 can be connected to store minimum and maximum values that will be stored in memory for an extended period, such as over a weekend: useful for monitoring in the absence of chart recorders.

Relative Mode

Often a technician will need to know how much one reading differs from another. By taking the first reading as a reference then pressing the “REL” button, the succeeding measurements will display only the deviation from the reference.

Specifications

Technical Specifications

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0 mV	100 µV	0.1% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ in parallel with <100 pF
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc 50 Hz or 60 Hz; ≤1kΩ unbalance
Overload Protection V: 1000V rms
Overload Protection mV: 500V rms
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Reso-lution	Accuracy: ±(% of Rdg + Digits)		
		40 Hz-2 kHz	2 kHz-10 kHz	10kHz-30 kHz
320.0 mV	100µV	0.5% + 3	2% + 3	4%+10
3.200V	1 mV			
32.00 mA	10 mV			
320.0V	100 mV			
1000V	1V	1% + 3	3% + 3	Not spec

Input Impedance: 10 MΩ in parallel with <100 pF
Common Mode Noise Rejection: ≥60 dB from dc to 60 Hz; ≤1kΩ unbalance
Overload Protection V ac: 1000V rms (10^7 volthertz max)
Overload Protection mV ac: 500V rms (10^7 volthertz max)
Response Time: ≤2 s to rated accuracy

DC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Typical Burden Voltage
320.0 µA	0.1 µA	0.75% + 2	0.5 mV/µA
3200 µA	1 µA		0.5 mV/µA
32.00 mA	0.01 mA		5.6 mV/mA
320.0 mA	0.1 mA		5.6 mV/mA
10.00A	0.01A		50 mV/A

Input Protection: µA/mA ranges, 630 mA/250V fuse in series with 3A/600V fuse; 10 amp range, 20A/600V fuse
Response Time: ≤2 s to rated accuracy

AC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Typical Burden Voltage
320.0 µA	0.1 µA	1.5% + 2*	0.5 mV/µA
3200 µA	1 µA		0.5 mV/µA
32.00 mA	0.01 mA		5.6 mV/mA
320.0 mA	0.1 mA		5.6 mV/mA
10.00A	0.01A		50 mV/A

**40 to 1000 Hz*

Overload Protection: Same as DC current
Response Time: ≤4s to rated accuracy

Resistance

Range	Resolution	Response Time	Accuracy ±(% of Rdg + Digits)
320.0Ω	0.1Ω	6s	0.3% + 2
3.200 kΩ	1Ω	2s	0.2% + 2
32.00 kΩ	10Ω		
320.0 kΩ	100Ω		
3.200MΩ	1 kΩ		
32.00 MΩ	10 kΩ	6s	1% + 1

Overload Protection: 500V rms
Open Circuit Test Voltage: <2.8V dc
Full Scale Voltage: Up to 3.2 MΩ <420 mV dc; 32 MΩ <1.3V dc

Conductance:

Measures up to 32.00 nS (to 100,000 MΩ) with 0.01 nS resolution accurate to ±1% + 10; full scale voltage <1.3V dc
Response Time: ≤6s to rated accuracy

Diode Test/Continuity Test

Overload Protection	Open Circuit Test Voltage	Typical Test Current	Display Voltage
500V rms	<3.3V dc	0.7 mA	0.0V
		0.5 mA	0.6V
		0.3 mA	1.2V
		0.1 mA	2.0V

General Specifications

MIN/MAX Mode (27 only): Records the digital display readings (updated twice per second)
Display: 3 1/2- digits 3200 counts autopolarity, autozero
Common Mode Voltage: 1000V between any terminal and earth ground
Shock, Vibration and Water Resistance: Per MIL-T-28800 Class 2 Style A
Temperature: Storage -55°C to 85°C; Operation -15°C to 55°C
Temperature Coefficient: 0.1 x (specified accuracy) per °C for temperatures <18°C or >28°C
Electro-Magnetic Interference (EMI): The 25 & 27 meet MIL-STD-461 for RS03 (radiated susceptibility to 1V/meter from 14 kHz to 1 GHz) and REO2 (radiated emissions).
Relative Humidity: 0% to 95% (0°C to 35°C) 0% to 70% (35°C to 55°C)
Power: Single 9V NEDA 1604 or 6F22 or 006P
Battery Life: >1000 hours typical
Battery Indicator: Symbol first diplayed when 60 hours of life remain
Safety: Protection Class II per IEC 348, ANSI C39.5, UL 1244 listed. Meets MIL-STD-810C, Method 511.1, Procedure/Explosive Atmosphere Test
Size: 56 mm H x 95 mm W x 203 mm L (2.2 in H x 3.75 in W x 8 in L)
Weight: 0.75 kg (1.6 lb)
C20 Case Size: 102 mm H x 152 mm W x 262 mm L (4 in H x 6 in W x 10.3 in L)
Note: Case is 13 in (330mm) L including handle
Warranty: 3 years; calibration guaranteed for one year
Includes: Battery installed, TL70 Test Leads, two insulated alligator clips, spare fuse, and Operator's manual

Available in dark umber (STD model) or yellow (YEL model).

Ordering Information

Models

January 1989 prices

Fluke 25 STD Multimeter	$199
Fluke 25 YEL Multimeter	199
Fluke 27* STD Multimeter	269
Fluke 27* YEL Multimeter	269

**With MIN/MAX storage and Relative Modes*

Accessories (Also see page 127)

TL20 Test Lead Set	35
TL70 Replacement Test Leads	8
Y8134 Deluxe Test Lead Kit	22
Y8140 Test Lead Set	20
C20 Hard Carrying Case	20
C25 Soft Carrying Case	20
C100 Universal Carrying Case	30
83RF 100 mHz R. F. Probe	55
85RF 500 mHz R.F. Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
80J-10 Current Shunt	35
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400 AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600 AC Current Probe	119
80i-1010 DC/AC Current Probe	229
LCA-10 Line Current Test Adapter	13

Service & Support

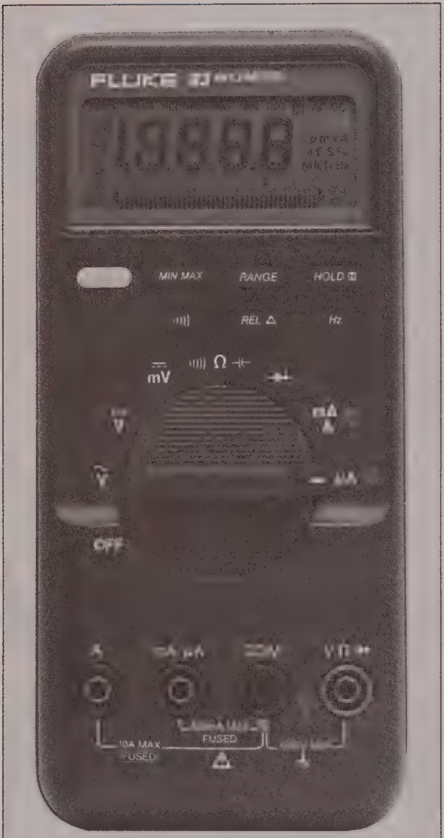
Warranty

Two-year product warranty. See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)

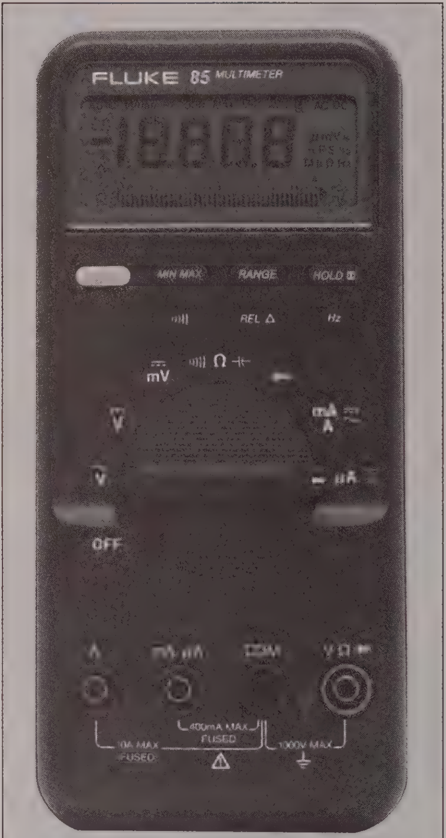
80 Series

NEW



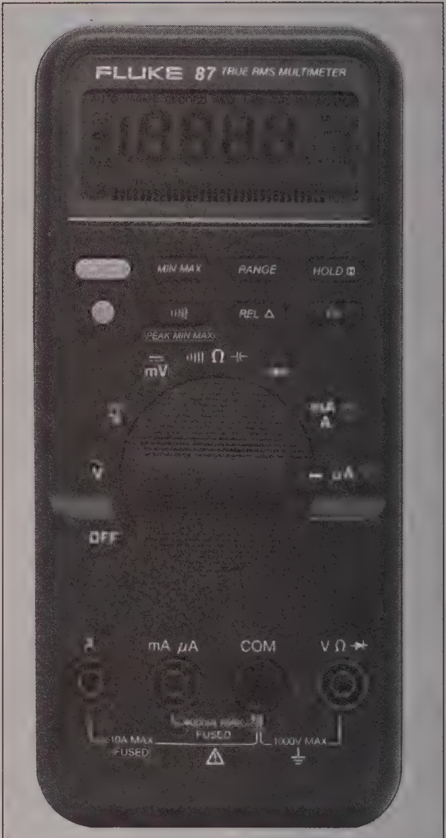
Fluke 83

NEW



Fluke 85

NEW



Fluke 87

Fluke 83 Analog/Digital
3-3/4 digit, 4000 counts
0.3% basic dc accuracy
43 segment analog bargraph
Frequency & duty cycle
Capacitance
Touch Hold® & Relative
3 year warranty

Fluke 85 Analog/Digital
3-3/4 digit, 4000 counts
0.1% basic dc accuracy
43 segment analog bargraph
Frequency & duty cycle
Capacitance
Touch Hold® & Relative
3 year warranty

Fluke 87 Analog/Digital
3-3/4 digit, 4000 counts
0.1% basic dc accuracy
Analog pointer
Frequency & duty cycle
Capacitance
Touch Hold® & Relative
True RMS ac voltage & current
1 ms Peak MIN MAX
4-1/2 digit mode
Back lit display
3 year warranty

The new Fluke 80 Series (83, 85, and 87) is a family of versatile analog/digital multimeters with an impressive range of capabilities, including frequency, duty cycle and capacitance measurement.

Designed for electronic as well as industrial applications, the 80 Series' durable construction and unique safety features ensure reliability and optimal performance in a variety of environmental settings.

MIN/MAX AVERAGE recording mode with Min Max Alert ™

Stores the highest, lowest, and average of all readings, allowing you to monitor a signal for seconds or days. Selectable response times allow you to specify the time required to sense changes. Min Max Alert™ gives an audible tone for readings above or below previous minimums or maximums.

Frequency, Duty Cycle and Capacitance Measurements

Fluke 80 Series meters have a counter for frequency measurements from 0.5 Hz to 200 kHz, and duty cycle measurements from 0.1% to 99.9% of cycle. All three meters measure capacitance from 10 pF to 5 µF. Larger value capacitors may be measured using the analog display in the resistance mode.

Input Alert and Overload Protection

Input Alert™ provides an audible warning when current jacks are used and a non-current function is selected. This reduces the risk of damage to the equipment being tested and to the meter. Fluke 80 Series meters also provide 1,000 volt input protection in both ohms and diode test.

Fast 3-3/4 digit, 4000 count digital display, high resolution analog display

Ensures greater accuracy and resolution. Digital display updates 4 times/second.

For changing or unstable signals, the 87 features a high-resolution analog pointer; the 83 and 85 use an analog bargraph. The 83 and 85 also feature Zoom Mode for higher resolution analog readings. Analog displays update 40 times per second.

4-1/2 digit mode, 1 ms peak hold, true rms, backlit display (87 only)

The Fluke 87 is a true-rms meter, and offers a 4-1/2 digit, 19,999 count high resolution mode, plus 1 ms peak hold. The backlit display assures readability in poorly lit settings. Light shuts itself off 68 seconds after the button is pressed, prolonging battery life.

Touch Hold™ and Relative Modes

Touch Hold captures the measurement, beeps and locks it on the digital display until you're ready to view it. It automatically updates with each new measurement.

The Relative Mode remembers a reading and shows the change (difference) between it and any readings that follow.

Rugged, Sealed Construction

Splash and dust proof case and a specially designed protective holster protects the meter even under harsh operating conditions. All units are sealed and EMI shielded.

Standard Equipment

Every meter comes packaged with a yellow protective holster complete with a Flex-Stand™, safety-designed test leads, 9V battery (installed), manual and operator guide.

Specifications

Technical Specifications

Basic electrical specifications are given as ± ([% of reading] + [number of least significant digits]) for the temperature range of 18°C to 28°C and relative humidity less than 90%, for one year after calibration.

DC Voltage

	83	85/87
Range	**Accuracy: ±(% of Rdg+Digits)**	
400.0 mV, 4.000V, 40.00V, 400.0V 1000V	0.3% + 1	0.1% + 1

Maximum Resolution: 0.1 mV in 400.0 mV range
Input Impedance: 10 MΩ (nominal), <100 pF
Normal Mode Rejection Ratio: >60 dB @ 50 Hz or 60 Hz
Common Mode Rejection Ratio: >120 dB @ dc, 50 Hz or 60 Hz
Overload Protection: 1000V rms

AC Voltage

ac V	83	85	87
50 Hz-60 Hz			
400.0 mV	±(1%+4)	±(0.5%+4)	±(0.7%+4)
4.000V, 40.00V, 400.0V	±(1%+3)	±(0.5%+2)	±(0.7%+2)
1000V	±(1%+3)	±(0.5%+2)	±(0.7%+2)
45 Hz-5 kHz			
400.0mV	±(1.5%+4)	±(1%+4)	±(1%+4)
4.000V, 40.00V, 400.0V	±(1.5%+3)	±(1%+2)	±(1%+4)
1000V	±(2.5%+3)	±(2%+2)	±(1%+4)**
5 kHz-20 kHz			
400.0mV	—	±(2%+4)	±(2%+4)**
4.000V, 40.00V, 400.0V	—	±(4%+4)	±(2%+4)**
1000V	—	unspecified	unspecified

***Add 16 counts below 10% of range*

Maximum Resolution: 0.1 mV in the 400.0 mV range
Conversion Type: 83/85 average, 87 True RMS
Input Impedance: 10 MΩ (nominal), 100 pF
Common Mode Rejection Ratio: >60 dB @ dc to 60 Hz
Overload Protection: 1000V rms

DC and AC Current (45 Hz to 2 kHz)

	83	85	87	Burden Voltage
AC Range	**Accuracy: ±(% of Rdg+Digits)**			
400.0µA, 4000µA	1.2%+2	0.6%+2	1.0%+2	100 µV/µA
40.00mA, 400.0mA	1.2%+2	0.6%+2	1.0%+2	1.5 mV/mA
4000mA, 10.00A*	1.2%+2	0.6%+2	1.0%+2	0.03 V/A
DC Range	**Accuracy: ±(% of Rdg+Digits)**			
400.0µA, 4000µA	0.4%+2	0.2%+2	0.2%+2	100 µV/µA
40.00mA, 400.0mA	0.4%+2	0.2%+2	0.2%+2	1.5 mV/mA
4000mA, 10.00A*	0.4%+2	0.2%+2	0.2%+2	0.03 V/A

**10A continuous, 20A for 30 seconds maximum*

Maximum Resolution: 0.1 µA in the 400 µA range
Overload Protection:
µA/mA Ranges: 1A 600V FAST fuse
Amp Range: 15A 600V FAST fuse

80 Series

Ohms

Range	83	85/87
	Accuracy: ±(% of Rdg+Digits)	
400.0Ω, 4.000 kΩ, 40.00 kΩ 400.0 kΩ, 4.000 MΩ	0.4% + 1	0.2% + 1
40.00 MΩ 40.00 nS	1.0% + 3 1.0% + 10	1.0% + 3 1.0% + 10

Maximum Resolution: 0.1Ω in the 400.0Ω range
Overload Protection: 1000V rms for circuits <0.3A short circuit, 660V for high energy circuits
Full Scale Voltage: <450 mV dc up to 4.0 MΩ <1.3V dc for 40 MΩ or nS
Open Circuit Voltage: <1.3V

Frequency (0.5 Hz to 200 kHz, pulse width >2 µS)

Range	Accuracy: ±(% of Rdg+Digits)
199.99, 1999.9 19.999 kHz, 199.99 kHz	0.005% + 1
>200 kHz	Unspecified

Maximum Resolution: 0.01 Hz on the 199.99 Hz range
Duty Cycle: 0.0 to 99.9%
Accuracy: Within ±(0.05% per Hz + 0.1%) of full scale for a 5V logic family input on the 4V dc range; within ±((0.06 x voltage range/input range) x 100%) of full scale for sine wave inputs on ac voltage ranges

Capacitance

Range	Accuracy: ±(% of Rdg+Digits)*
5.00 nF	1.0% + 35**
0.0500 µF, 0.500 µF 5.00 µF	1.0% + 2

**Accuracy with film capacitors or better*
***±(1.0% + 2) if Relative mode is used for zero residual*

Maximum Resolution: 0.01 nF on the 5.00 nF range

Diode Test and Continuity

Diode Test Indication: Display voltage drop; 0.8 mA nominal test current at 0.6V; 3.0V full scale, accuracy:±(2.0% + 1)
Continuity Indication: Continuous audible tone for test resistance below 20Ω
Open Circuit Voltage: <3.9V dc
Overload Protection: 1000V rms for circuits <0.3A short circuit, 660V for high energy circuits.

Display

Digital: 4000 counts, updates 4 times per second
Analog: 43 segments, updates 40 times per second (for 83 and 8)
4 x 32 segments (equivalent to 128), updates 40/sec. (for 87)
Frequency: 19,999 counts, updates 3 times per second @ >10 Hz
Annunciators: u, m, n, k, M, V, A, F, S (siemens), Ω (ohms), Hz, AC, DC, MIN, MAX, RECORD, (AUTO autorange), (duty cycle), (hold), (low battery), (audible continuity), (relative),

General Specifications

Maximum voltage applied to any earth terminal: 1000V rms
Storage Temperature: - 40°C to 60°C
Operating Temperature: -20°C to 55°C
Temperature Coefficient: 0.05 x (specified accuracy) per °C (for temperatures <18°C or >28°C)
Relative Humidity: 0% to 90% (0°C to 35°C) 0% to 70% (35°C to 55°C)
Shock & Vibration: Per MIL-T-28800 for a Class 2 Instrument
Safety: Designed to Class II per IEC 348, ISA-DS82, and UL 1244
Power Requirements: Single 9V battery (NEDA 1604 or 6F22 or 006P)
Battery Life: 500 hours typical (alkaline). Battery symbol first displayed when at least 60 hours of battery life remain
Size: 1.25 in H x 3.41 in W x 7.35 in L (32 mm H x 87 mm W x 187mm L).
With holster and Flex-Stand:
2.06 in H x 3.86 in W x 7.93 in L (52 mm H x 98 mm W x 201 mm L)
Weight: 12.5 oz (0.36 kg). With holster and Flex-Stand 22.0 oz (0.62 kg)
Warranty: Three years parts and labor. One year calibration cycle

Ordering Information

Models

January 1989 prices

Model	Price
Fluke 83 Multimeter	$189
Fluke 85 Multimeter	219
Fluke 87 Multimeter	259

Accessories (Also see 127)

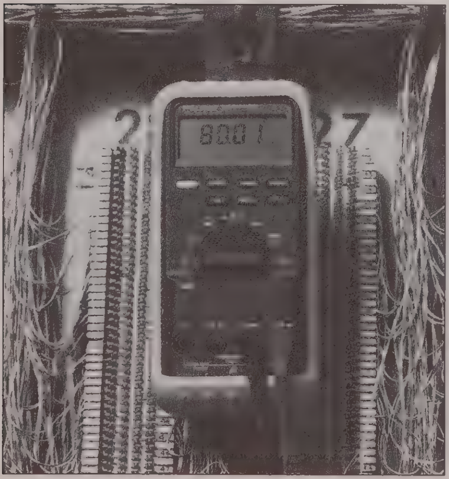
Item	Description	Price
C81G	Optional Grey Holster	14
C81Y	Replacement Yellow Holster	14

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)



Protective Holster

FlexStand™

8025B

8025B

8025B Multimeter

Designed for MIL-T-28800 Type II, Class 2, Style A requirements
3-1/2 digit, 3200 count display
31 segment bar graph for peaking, nulling and capacitor checking
0.2% basic dc accuracy
Touch Hold® to capture and display readings
LCD symbols annunciate range and modes
Safety designed with extensive overload protection, non-metallic case, and bail
Rugged sealed construction keeps out dirt, water, and contaminants
Comes with C100 ruggedized hard case and low temperature test leads
-40 to 55°C operating range
One year calibration interval
Two year warranty
Fast autoranging or manual ranging
Range hold
Continuity/diode test beeper
1k ohm shunted stray-voltage test leads

Designed for use in harsh military environments, the 8025B offers the performance and accuracy of a digital multimeter with the speed and dynamic measurement capability of an analog meter. The 8025B offers bench instrument performance in a convenient hand-held package.

3200-Count Digital Display

The 8025B 3-1/2 digit (3200 count) display equals the resolution of a 4-1/2 digit meter for reading between 2 and 3.2, 20 and 32, or 2000 and 3200.

The analog bar graph allows quicker, easier testing for erratic or unstable signals. It updates ten times faster than the digital display.

Autoranging

Simplifies and speeds up the use of the meter. No need to decide what range to use or to wait for long range-changing delays. Manual ranging is also included.

Audible Continuity/Diode Test

Wiring, diode, and transistor checks can be done quickly without looking at the display.

Touch Hold®

You can take readings of critical circuitry while keeping your eyes on the probes and circuit. Using standard test leads, the 8025B captures your measurement, beeps, locks the reading in the display for viewing, and then automatically updates when a new measurement is taken.

Safety

Safety is designed in with extensive overload protection, high energy fuses, fused 10A range, non-metallic case and bail, recessed input jacks, safety-designed test leads, and no fuses to replace for voltage and resistance overloads.

Low Power Resistance

In-circuit resistance measurements can be made without turning on diodes or transistors.

Min/Max Mode

The 8025B can be connected to record minimum and maximum values that will be stored in memory for an extended period, such as over a weekend: useful for monitoring in the absence of chart recorders.

Relative Mode

Often a technician will need to know how much one reading differs from another. By taking the first reading as a reference then pressing the "REL" button, the succeeding measurements will display only the deviation from the reference.

8025B

Display

Liquid Crystal
Digital Display: 3200 counts plus polarity indication, updated 2 times per second
Analog Display: 31 segment bar graph plus polarity indication, updated 25 times per second
Annunciators: k, M, Ω (Ohms); (Hold); (low battery); (manual range); 3,30,300 (range indicators); nS (nanosiemens)

Specifications

Technical Specifications

Basic electrical specifications are defined for the temperature range of 18°C to 28°C and relative humidity up to 95%, for one year after calibration.
Low Temperature Operation: at -40°C LCD updates may take more than 6 seconds

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0 mV	100 µV	0.2% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ nominal
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc 50 Hz or 60 Hz; ≤1kΩ unbalance
Overload Protection V: 1000V rms; 500V rms on 320 mV range
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		
		40 Hz-2 kHz	2 kHz-10 kHz	10 kHz-30 kHz
320.0 mV	100 µV	0.5%+3	2% + 3	4%+10
3.200V	1 mV			
32.00V	10 mV			
320.0V	100 mV			
1000V	1V	1% + 3	3% + 3	Not Spec'd

Conversion Type: AC coupled, average sensing, calibrated to read rms value of sinewave
Input Impedance: 10 MΩ nominal in parallel with ≤100 pF
Common Mode Rejection Ratio: ≥60 dB, DC to 50 Hz; ≤1kΩ unbalance
Overload Protection: 1000V rms, 500V rms on 320 mV range; 10 volt-hertz maximum
Response Time: ≤2 s to rated accuracy

DC and AC Current

Range	Resolution	Typical Burden Voltage	Accuracy: ±(% of Rdg + Digits)	
			DC Accuracy	AC 40 Hz to 1 kHz
320.0 µA	0.1 µA	160 mV	0.75% +2	1.5% +2
3200 µA	1 µA	1.6		
32.00 mA	10 µV	180 mV		
320.0 mA	100 µA	1.8V		
10.00A	10 mA	0.5V		

Overload Protection: µA/mA ranges: 630 mA/250V fuse in series with 3A/600A fuse
Amp range: 20A/600V fuse

Resistance

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0Ω	0.1Ω	0.3% + 2
3.200k	1Ω	0.2% + 1
32.00k	10Ω	
320.0k	100Ω	
3.200M	1 kΩ	
32.00M	10 kΩ	1% + 1
32.00 nS	0.01 nS	2% + 10

Overload Protection: 500V rms
Full Scale Voltage: <420 mV up to 3.2 MΩ <1.3V up to 32 MΩ
Open Circuit Voltage: <2.8V (-15°C to 55°C)
Response Time: ≤6s to rated accuracy

Diode Test and Continuity

Diode Test Indication: Displays voltage drop; 0.5 mA nominal test current at 0.6V; 2.08V full scale
Continuity Indication: Continuous audible tone for test resistance below 150 ohms. Momentary tone for test voltage dropping below 0.7V (typical silicon diode threshold)
Open Circuit Voltage: <3.3V (-15°C to 55°C)
Overload Protection: 500V rms

General Specifications

MIN/MAX Mode: Records the digital display readings (updated twice per second)
Maximum Voltage to be applied to any terminal: 1000V with respect to earth ground
Power Requirements: Single 9V battery NEDA 1604. Lithium battery recommended for low temperature operation
Battery Life: 1000 hours typical. Battery symbol first displayed when at least 60 hours of battery life remain. Battery life shortens significantly at low temperature. Lithium battery recommended for low temperature operation.
Instrument Size: 56 mm H x 95 mm W x 203 mm L (2.2 in H x 3.75 in W x 8 in)
C100 Case Size: 121 mm H x 337 mm W x 394 mm L (4.75 in H x 13.25 in W x 15.5 L)
Weight: DMM alone is 0.75 kg (1.6 lb) with case and accessories 1.5 kg (3.2 lb)
Storage Temperature: -55°C to 85°C
Operating Temperature: -40°C to 55°C
Temperature Coefficient: 0.1 x applicable accuracy specification per °C (for temperatures <18°C or >28°C)
Electro-Magnetic Interference (EMI): The 8025B meet MIL-STD-461 for RS03 (to 1V/meter from 14 kHz to 1 GHz) and RE02
Shock, Vibration, Humidity and Water Resistance: Per MIL-T-28800 for a Style A, Class 2 instrument
Included: Battery, low temperature test leads, two insulated alligator clips, instruction manual, TL25B stray voltage test lead set, with a 1k ohm thermistor load for DMM input, and C100 ruggedized hard case

Ordering Information

Model

	January 1989 prices
8025B Multimeter	$364

Accessories (Also see page 127)

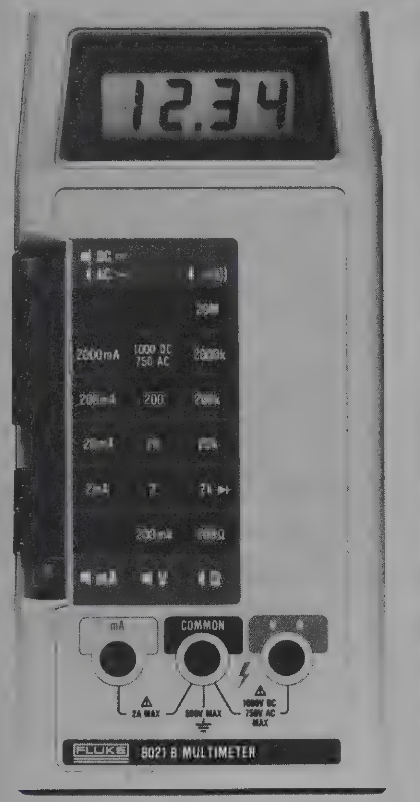
TL25B Stray Voltage Test Leads	45
Y8134 Deluxe Test Lead Kit	22
C25 Soft Carrying Case	20
83RF 100 MHz RF Probe	55
85RF 500 MHz RF Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
80 K-6 HV Probe	49
80 K-40 HV Probe	85
80J-10 Current Shunt	35
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400 AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600 AC Current Probe	119
80i-1010 DC/AC Current Probe	229
LCA-10 Line Current Test Adapter	13

Service & Support

Warranty

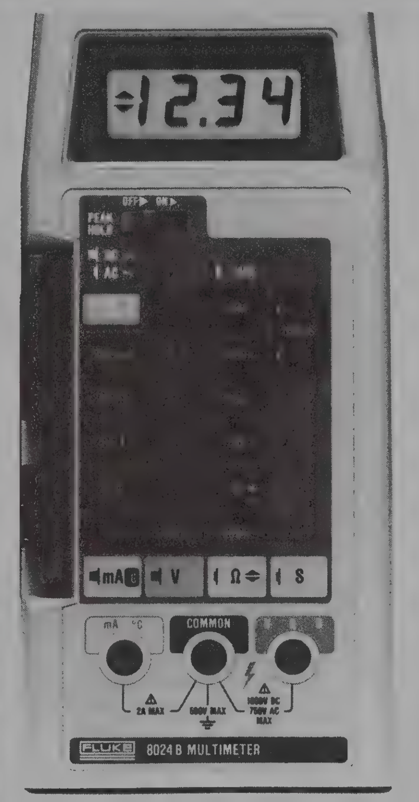
Two-year product warranty. See page 470 for further information on warranty terms and conditions.

8020B, 8021B, 8024B & 8026B (B-Series)



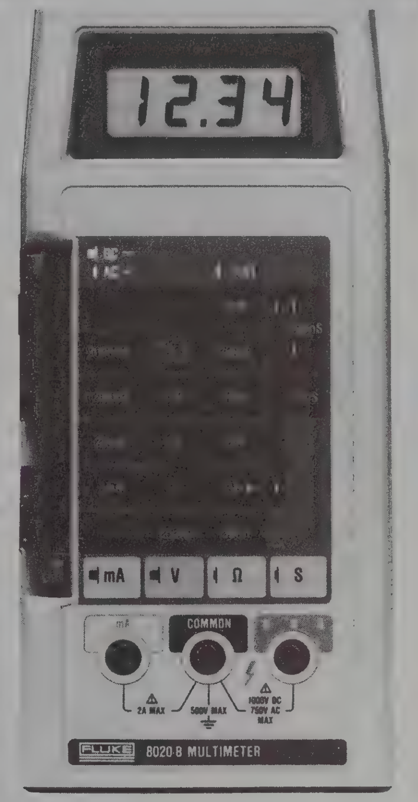
LISTED UL 1244

8021B



LISTED UL 1244

8024B



LISTED UL 1244

8020B

8021B, Rugged & Economical

- 3-1/2 digits (2000 counts)
- Six functions including diode test
- High-speed audible continuity
- 0.25% basic dc accuracy
- 2-yr warranty, 2-yr calibration cycle
- Tilt bail with detent position
- Extensive overload protection
- UL 1244 listed
- Shock and vibration per MIL-T-28800, Class 5

8024B More than a DMM

- 3-1/2 digits (2000 counts)
- High speed audible continuity (50 µs response)
- Peak-hold (10 ms response)
- Temperature (with any K-type thermocouple)
- Logic level detection
- Conductance
- 0.1% basic dc accuracy
- 2-yr warranty, 2-yr calibration cycle
- Full overload protection
- Fast ac or dc transient capture
- Shock and vibration per MIL-T-22880, Class 5
- Tilt bail with detent position
- UL 1244 listed

8026B & 8020B Professional Precision

- 3-1/2 digits (2000 counts)
- All basic DMM functions
- Conductance
- Diode Test
- True rms (8026B only)
- 0.1% basic dc accuracy
- High-speed audible continuity testing
- Tilt bail with detent position
- Extensive overload protection
- UL 1244 listed
- Shock and vibration per MIL-T-22880, Class 5
- Two year warranty

8020B, 8021B, 8024B & 8026B (B-Series)

8021B

This rugged 3-1/2 digit handheld DMM was designed for the person who needs the following six basic measurement functions: dc and ac volts, dc and ac amps, ohms, and diode test.

Both electrical and mechanical features make the DMM the world's best in its class. For instance, the 8021B meets the vibration and shock test requirements for Class 5 instruments outlined in U.S. Military Specification MIL-T-28800. Overload protection circuits prevent damage to the instrument caused by accidental operator errors, including voltage input transients up to 6 kV. The current input has two in-series fuses, one for normal overload situations — a common 2A, 250V variety — and a second for high-energy fault conditions, like accidentally connecting the DMM to a 480V ac power line. A crystal-controlled oscillator gives the Fluke handheld DMM the best 60 Hz or 50 Hz line noise rejection available in any hand-held DMM.

The simple front panel layout makes the DMM easy to use. A comprehensive owner's manual clearly explains the unit's operation, and typical measurement techniques are covered so you can get the most out of your DMM.

8024B

Designed with the field serice technician in mind, this instrument provides a unique combination of functions that reduces the number of tools needed for on-location repairs. Temperature capability (use any K thermocouple), peakhold (measure motor starting currents or line transients), and a logic level indicator in combination with features more commonly found on DMMs will make this multimeter an integral part of any customer service tool kit.

The 8024B, like all Fluke handheld DMMs, will withstand the rigors of field service. It is used around the world by people who demand exceptional performance, reliability, and ruggedness.

Peak-Hold

This function works for dc or ac voltage or current measurements and is for capturing transient dc peaks or ac surges. For dc, the most positive value will be displayed on the LCD, and peaks typically as short as 5 ms are captured. Average-sensing, rms-indicating techniques are used for ac for transients as short as 150 ms for 48 to 450 Hz waveforms. The decay rate of the display is less than one digit per second.

This feature is especially useful for measuring voltage pulses in electro-mechanical equipment or surge currents in electric motors. Currents as high as 1000 amps may be measured using the optional current probe 80i-1010 clamp-on ac/dc current probe.

Temperature

The 8024B directly displays temperature (in degrees Celsius) when used with optional K-type thermocouples. The input of the 8024B has a temperature-compensated reference junction.

Temperatures from -20°C to +1265°C can be measured depending on which of the following K-type thermocouples are used: the Y8102 is a sheathed probe, good to +925°C, for liquid immersion or penetration measurements; the Y8103 is a bead thermocouple, good to +260°C, for air or gas temperature measurements. The Y8104 is a termination kit for attaching any K-type thermocouple to the 8024B.

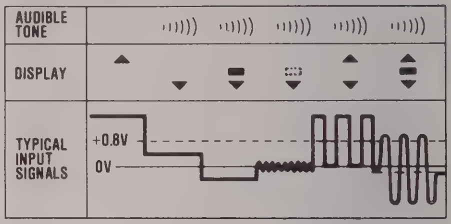
Now you can measure component heat rise, motor temperatures, heating and cooling equipment, etc.

Fluke's high-resolution semiconductor temperature probe, the 80T-150U, will also work with the 8024B as well as all other Fluke DMMs. It has better resolution and accuracy but covers a smaller temperature range (to +150°C or +302°F). The 80T-150U is suited for surface, air, and some liquid immersions.

Logic Level Detection

This function serves the same purpose as an oscilloscope or logic probe in detecting level transitions that last 50 microseconds or longer.

A pulse stretcher is used to detect low-duty cycle pulses .



8026B & 8020B

Both the 8026B and 8020B provide features that make them ideal for troubleshooting relays, cables, switches, and for locating intermittent shorts and opens. The 8026B and 8020B offer capabilities that allow you to check leakage current of diodes, cable insulation, connectors, printed circuit boards, etc.

The 8026B and 8020B are equipped with extensive internal protection against overloads, transients to 6 kV, or operator errors. The current input is protected with two in-series fuses —2A/250V and 3A/600V. In normal overload situations, only the common 2A/250V fuse will blow. The 3A/600V fuse will blow when accidentally attached to a source of more than 250 volts —like a 480-volt power line. Over 20% of the components are devoted exclusively to overload protection.

True RMS

Most ac meters are accurate only when measuring sinewaves. In modern electronic and electrical equipment, however, measurement errors on the order of 20% or more may result from radically non-sinusoidal waveforms such as squarewaves, pulses, or the outputs from silicon controlled rectifiers. True-rms sensing circuits such as found in the 8026B prevent such errors.

Specifications

B-Series*

DC Voltage

	8021B	8020B	8024B	8026B
Accuracy*	200 mV, 2V 20V, 200V, 1000V ranges Highest resolution 100 µV on 200 mV range. 0.25% + 1	0.1% + 1	0.1% + 1	200mV,2V,20V,200V, 1000V ranges Highest resolution 100 µV on 299 mV range 0.1% + 1
Overload Protection	1000V dc or peak ac on all ranges except 200 mV (15 sec. max. above 300V dc or rms). 6 kV, 10 µsec pulses, maximum 5 pulses/sec.)			1000V dc or peak ac on all ranges except 200 mV (15 sec. max. above 300V dc or rms). (6 kV, 10 µsec pulses, maximum 5 pulses/sec.)
Input Impedance	10 MΩ			10 mΩ
NMRR	>60 dB (50 Hz, 60 Hz)			>60 dB (50 Hz, 60 Hz)
CMRR (kΩ unbalance)	>100 dB at dc 50 Hz, 60 Hz			>100 dB at dc 50 Hz, 60 Hz

AC Voltage

Accuracy*

	8021B	8020B/8024B		
Range	**45 Hz to 450 Hz**	**45 Hz to 1 kHz**	**to 2 kHz**	**to 5 kHz**
200 mV	1.0% + 3	0.75% + 2	1.5% + 3	5% + 5
2V	1.0% + 3	0.75% + 2	1.5% + 3	5% + 5
20V	1.0% + 3	0.75% + 2	1.5% + 3	5% + 5
200V	1.0% + 3	0.75% + 2	1.5% + 3	—
750 V	1.0% + 3	1.0 % + 2	—	—

8026B: >5% of range

Range	45 Hz-1 kHz	to 2 kHz	to 5 kHz	to10 kHz
200 mV	0.5%+2	0.5%+2	0.5%+2	2%+3
2V	0.5%+2	0.5%+2	1%+3	2%+3
20V	0.5%+2	0.5%+2	1%+3	2%+3
200V	0.5%+2	1%+2	—	—
750V	0.5%+2	—	—	—

	8021B, 8020B, 8024B	8026B
Overload Protection	750V ac, 100V dc on all range except 200 mV (15 sec. max. above 300V rms)	750V ac, 100V dc on all range except 200 mV (15 sec. max. above 300V rms)
Input Impedance	10 MΩ (<100 pF)	10 MΩ (<100 pF)
CMRR (1kΩ unbalance)	<60 dB (50 Hz, 60 Hz)	<60 dB (50 Hz, 60 Hz)
Crest Factor:	Does not apply	1:1 to 3:1
Conversion Type	Average sensing, calibrated to tread rms of sine wave.	True rms ac coupled

Current

Accuracy (dc)*

Highest resolution 1 µA on 2 mA range

Range	**8021B**	**8020B**	**8024B**
2 mA, 20 mA,200 mA, 2000 mA ranges	0.75% + 1	0.75% + 1	0.75% + 1

8026B: Highest resolution 1 µA on 2 mA range

2 ma, 20 mA, 200 mA, 2000 mA ranges 0.75% + 1

Accuracy (ac)*

	8021B	8020B	8024B
2 mA (45-450 Hz)	3.0% + 3	3.0% + 2	4.0% + 2
20 mA, 200 mA, 2000 mA (45-450 Hz)	2.0% + 3	1.5% + 2	1.5% + 2
(to 1 kHz)	—	1.5% + 2	1.5% + 2

8026B:

Range	**45 Hz-450 Hz***	**to 1 kHz***
2 mA	3.0% + 2	—
20 mA	1.5% + 2	1.5% + 2
200 mA	1.5% + 2	1.5% + 2
2000 mA	1.5% + 2	1.5% + 2

	8021B, 8020B, 8024B	8026B
Overload Protection	2A/250V fuse in series with 3A/600V fuse	2A/250V fuse in series with 3A/600V fuse
Burden Voltage	<0.3V all ranges (<0.9V on 2000 mA)	<0.3V all ranges (<0.9V on 2000 mA)

**True RMS ac coupled*

8020B, 8021B, 8024B & 8026B (B-Series)

Specifications, continued

Resistance Conductance

		8021B	8020B	8024B	8026B	
Accuracy	Range	**8021B**	**8020B**	**8024B**	Range	
	200Ω	0.3% + 3	0.2% + 3	0.2% + 3	200Ω	0.2% + 3
	2 kΩ to 200 kΩ	0.2% + 1	0.1% + 1	0.1% + 1	2 kΩ to 200 kΩ	0.1% + 3
	2000 kΩ	2.0% + 1	2.0% + 1	0.15% + 1	2000 kΩ, 20 MΩ	2.0% + 1
	20 MΩ	2.0% + 1	2.0% + 1	2.0% + 1	2 mS	0.2% + 1
	2 mS	—	0.2% + 1	—	200 nS	2.0% + 10
	200 nS	—	2.0% + 10	2.0% + 10		
	Lowest resolution 0.1Ω on 200Ω range				Highest resolution on 0.1Ω on 200Ω range	
Continuity beeper (typical threshold)		<600Ω	<600Ω	<600Ω	<600Ω	
Diode Test	Use 2 kΩ, 200 kΩ 20 MΩ range				Use 2 kΩ, 200 kΩ 20 MΩ range	
Overload Protection	500V rms (15 sec. max. above 300V)				500V rms (15 sec. max. above 300V)	
Open Circuit Voltage	<1.5V for all ranges (3.5V on 2 kΩ)				<1.5V for all ranges (3.5V on 2 kΩ)	

General

Max. CM Voltage	500V with respect to earth ground	500V with respect to earth ground
Display	3-1/2 digit LCD (1999 count)	3-1/2 digit LCD (1999 count)
Temperature	Operating: 0°C to 50°C. Storage: -35°C to +60°C	Operating: 0°C to 50°C. Storage: -35°C to +60°C
Humidity	0 to 90% (0°C to 35°C) (0 to 80%, 2 MΩ, 20 MΩ and 200 nS ranges) 0 to 70T (35°C to 50°C)	0 to 80% (0°C to 35°C) 0 to 70% (35°C to 50°C)
Temperature Coefficient	0.1x specified accuracy/°C applies from 0°C to 18°C and from 28°C to 50°C	0.1x specified accuracy/°C applies from 0°C to 18°C and from 28°C to 50°C
Shock & Vibration	Per MIL-T-28800C, Class 3	Per MIL-T-28800C, Class 3
Power	Single 9V battery 200 hours (8021B, 8020B), 100 hours (8024B) (alkaline)	Single 9V battery 200 hours (alkaline)
Size	45 mm H x 86 mm W x 180 mm L (1.8 in H x 3.4 in W x 7.1 in L)	45 mm H x 86 mm W x 180 mm L (1.8 in H x 3.4 in W x 7.1 in L)
Weight	0.37 kg (13 oz), 8021B, 8020B, 0.48 kg (17 oz), 8024B	0.37 kg (13 oz)
Calibration	2 years for specified accuracy	1 year for specified accuracy
Warranty	2 years parts and labor	2 years parts and labor
Special Functions	Display hold, peak hold, temperature, level detector, (8024B)	

**Accuracy specifications are ±(% of reading + number of digits). Accuracy specified for temperature range of 18°C to 28°C.*

Ordering Information

Models

January 1989 prices

8020B DMM w/ 2-year warranty	$259
8021B DMM w/ 2-year warranty	209
8024B DMM w/ 2-year warranty	299
8026B DMM w/ 2-year warranty	269

Accessories (Also see page 127)

TL20 Test Lead Set	35
Y8132 Test Lead Set	11
Y8134 Deluxe Test Lead Kit	22
Y8140 Test Lead Set	20
C90 Soft Case	$15
A81 Battery Eliminator	20
83RF 100mHz RF Probe	55
85RF 500 mHz RF Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
80 K-6 HV Probe	49
80 K-40 HV Probe	85
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400 AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600 AC Current Probe	119
80i-1010 DC/AC Current Probe	229

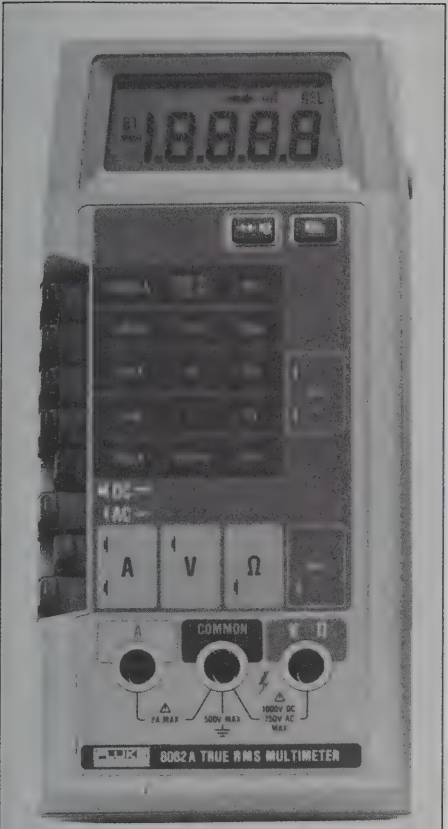
Service & Support

Warranty

Two-year product warranty. See page 470 for further information on warranty terms and conditions.

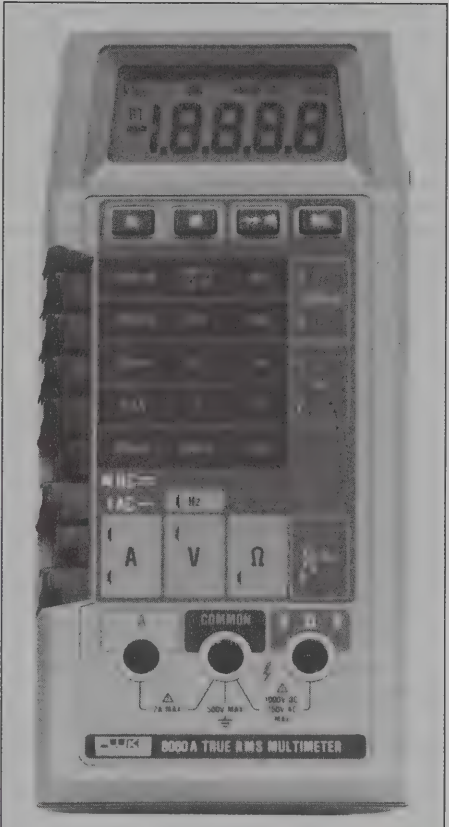
Available through Distributors (See page 500)

8060A & 8062A



(NSN 6625-01-160-4299) **8062A**

8062A 4-1/2 Digit DMM
4-1/2 digit (20,000 count) resolution
True-rms ac measurements
Fast audible/visual continuity tests
Relative reference (offset)
Low-power ohms all resistance ranges
Constant-current diode test mode
Measure resistances to 300 MΩ
True-rms ac voltages to 30 kHz
0.05% basic dc accuracy
Self diagnostics
UL 1244 listed



(NSN 6625-01-157-2246) **8060A**

8060A 4-1/2 Digit DMM
4-1/2 digit (20,000 count) resolution
True-rms ac measurements
Fast audible/visual continuity tests
Relative reference (offset)
Low-power ohms all resistance ranges
Constant-current diode test mode
Measure resistances to 300 MΩ
True-rms ac voltages to 100 kHz
0.04% basic dc accuracy
Self diagnostics
UL 1244 listed
Plus
Frequency Counter...12 Hz to 200 kHz
functional to 700 kHz
dBm or relative dB measurements
Conductance measurements

The 8060A and 8062A 4-1/2 digit handheld DMMs offer more measurement capabilities than found in most bench/portable models. They are Fluke's finest microcomputer-based handheld DMMs offering unique features never before found in a small low-cost DMM. The 8060A even measures *frequency*—from 12 Hz to more than 200 kHz—autoranging over four ranges from 200 Hz to 200 kHz.

At the touch of a single button you can select V, Hz, and dB.

Relative Reference

The microcomputer lets you automatically subtract lead resistance when measuring ohms and display only the difference between a stored reference value and a measured value. The relative mode is great for measuring changes, especially in dB and frequency measurements.

Overload Protected & Rugged

The 8060A and 8062A are well-suited to the needs of engineers and technicians skilled in audio, video, telecommunication, or computer technology. They have rugged cases, safety engineered jacks and test leads, double-fused current inputs, and extensive overload protection for all other functions and ranges.

Automatic MΩ Range Selection

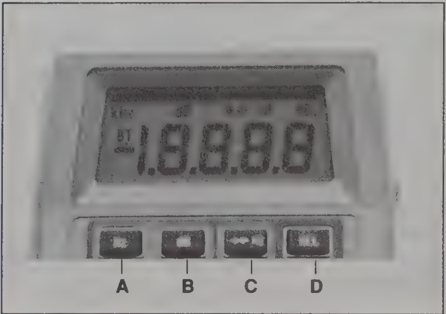
To keep the front panel simple, there is only one manually-selectable position above 200 kΩ. When that position is used, the appropriate 2 MΩ, 20 MΩ, or 300 MΩ range is automatically selected.

Frequency Counter

It is easy to accurately measure the dB gain or loss of amplifiers, filters, attenuators, etc. with a DMM that has dB readout. To combine that feature in a handheld DMM that also measures *frequency* provides a nearly ideal test instrument for many applications. When you need the best in a handheld DMM, you should buy the 8060A. It has features you won't find even in most bench/portable DMMs.

True-rms AC

Because true-rms measurements of ac yield accurate results on non-sinusoidal waveforms as well as sinewaves, the 4-1/2 digit resolution,



8060A & 8062A

wide bandwidth, and exceptional accuracy of the 8060A and 8062A make them a superior tool for exacting technical people.

Special Functions

Several special annunciator symbols appear in the display as a reminder of what mode or modes have been selected when pushbuttons **A**,**B**,**C**, and **D** are used. Only pushbuttons **C** and **D** and corresponding functions appear on the 8062A.

(A) Pushing the Hz button when in the ac voltage mode selects the frequency function. The best of four ranges (200 Hz, 2 kHz, 20 kHz, and 200 kHz) is then automatically selected for frequencies between 12 Hz and 200 kHz. Readings are updated every 1.3 seconds or less even for low-frequency ranges.

(B) Pushing the dB button converts voltage readings to the equivalent in decibels. The reading may be relative to 1 milliwatt (dBm) and a 600 ohm load, or they may be relative to any level previously stored as a "relative reference."

(C) This pushbutton converts resistance measurements to fast indications of continuity, either audibly with a beep tone or quietly by the appearance of the solid black bar across the top of the display. Continuity as brief as 50 microseconds is enough to be recognized, stored, and indicated.

(D) When you first push the REL button it stores the displayed reading and subsequently subtracts that value from all subsequent readings for that measurement function. REL appears in the display as a reminder until the 8060A or 8062A is turned off or the pushbutton is pressed a second time.

Specifications

Technical Specifications

All accuracy specifications apply for one year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 80%, unless otherwise noted.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V,
Resolution: 10µV on the 200 mV range
Input Impedance: 10 MΩ on all ranges, >1000 MΩ selectable for 200 mV and 2V ranges
Accuracy: ±(% of Rdg + Digits)

Range	8060A	8062A
200 mV, 2V	0.04% + 2*	-0.05% + 2
20V, 200V, 1000V	0.05% + 2	0.07% + 2

**Accuracy ± (0.05 of reading + 2 digits) for > 1000 MΩ input impedance*

Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc, ≥90 dB at 50 Hz and 60 Hz, with 1 kΩ unbalance

Overload Protection: 1000V dc, 750V rms ac (not to exceed a volt-hertz product of 10^7) on all ranges, continuous except limited to 20 seconds on 200 mV and 2V ranges
Response Time: ≤1 second to rated accuracy

AC Voltage (True-RMS, AC Coupled)

Ranges: 200mV, 2V, 20V, 200V, 750V
Resolution: 10µV on the 200 mV range
Inmput Impedance: 10 MΩ, ≤100 pF (dBm mode also)
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Voltage Readout, 8060A: From 5% to 100% of Range

Range	Accuracy: ±(% of Rdg + Digits)					
	20 Hz – 45 Hz	45 Hz – 1 kHz	1 kHz – 10 kHz	10 kHz – 30 kHz	30 kHz – 50 kHz	50 kHz – 100 kHz
200 mV	1% + 10	0.2% +10	0.2% +20	0.5% +40	1%+ 100	3%+ 200
2V 20V 200V		0.5% +10	0.5% +20	1% +40	2% 100	
750V	Not Spec'd	1% +10	Not Specified			

Voltage Readout, 8062A: From 5% to 100% of Range

Range	Accuracy : ±(% of Rdg + Digits)			
	20 Hz – 45 Hz	45 Hz – 500 Hz	500 Hz – 1 kHz – 10 kHz	10 kHz – 30 kHz
200 mV 2V	1% +10	0.5% +10	0.5% +20	1% +40
20V 200V			5% +20	5% +40
750V	Not spec	2% + 10		not Spec'd

dBm, 600Ω Reference, 8060A: From 5%to 100% of Range (-50 to +60 dBm)

Range	Accuracy in dB					
	20 Hz – 45 Hz	45 Hz – 1 kHz	1 kHz – 10 kHz	10 kHz – 30 kHz	30 kHz – 50 kHz	50 kHz – 100 kHz
2.45 mV- 10.23 mV	±0.5	±1.0		±3.0	Not spec'd	
10.24 mV- 19.99 mV	±0.2			±0.5	±1.0	±2.2
20 mV- 199.99V	±0.15			±0.3	±0.65	±1.2
200V-750V	±0.5		Not spec'd			

Useful Frequency Range: -3 dB at 420 kHz at 100% of range, 220 kHz at 5% of range, typical
Common Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc or peak ac, 750V rms ac (not to exceed a volt-hertz product of 10^7) on all ranges, continuous, except 300V dc or rms ac on the 200 mV and 2V ranges for 20 seconds maximum
Response Time: ≤5 seconds to rated accuracy, any range

DC Current

Range	Reso-lution	Accuracy: ±(% Rdg + Digits)		Burden Voltage
		8060A	8062A	
200 µA 2 mA	0.01 µA 0.1 µA	0.2% + 2	0.3% + 2	≤0.3V
20 mA	1 µA	0.3% + 2		
200 mA	10 µA		0.7% + 2	
2000 mA	100 µA			≤0.9V

Input Protection: 2A/250V fuse in series with 3A/600V fuse
Response Time: ≤1 second to rated accuracy

AC Current (True-RMS)

Has dc-coupled current path, ac-coupled voltage-sensing circuits
Ranges, Resolution, Burden Voltage: Same as for dc current
Accuracy, 8060A: ±(% of Rdg + Digits) From 5% to 100% of range

Range	20 Hz-45 Hz	45 Hz-3 kHz	3 kHz-10 kHz	10 kHz-30kHz
200 µA 2 mA 20 mA	1% +10	0.75% +10	2% +20	2% +40
200 mA				
2000 mA			Not Specified	

Accuracy, 8062A: ±(% of Rdg + Digits) From 5% to 100% of range

Range	20 Hz-45 Hz	45 Hz-3 kHz	3 k 10 kHz	10 kHz-30 kHz
200 µA 2 mA 20 mA	1% +10	0.75% +10	2% +20	2% +40
200 mA	1.5% +10	1% +10		
2000 mA			Not Specified	

Crest Factor: 1:1 to 3:1
Response Time: ≤5 seconds to rated accuracy

Resistance

Ranges: 200Ω, 2Ω, 20 kΩ, and 200 kΩ manually selected plus 2 MΩ, 20 MΩ, 100 MΩ, and 300 MΩ automatically selected in the MΩ range

Resolution and Accuracy

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		8060A	8062A
200Ω	0.01Ω	0.07% + 2 + 0.02Ω	0.1% + 2 + 0.02Ω
2 kΩ 20 kΩ 200 kΩ	0.1Ω 1Ω 10Ω	0.07% + 2	0.1% + 2
2 MΩ*	100Ω	0.15% + 2	0.2% + 2
20 MΩ*	10 kΩ	0.2% + 3	0.25% + 3
100MΩ*	100 kΩ	1% + 3	1% + 3
300 MΩ*	1 MΩ	2% + 3	2% + 3

**These four autoranging MΩ ranges have a high enough source voltage to turn on a silicon junction.*

Open Circuit Voltage: ≤2.5V all ranges, except ≤4.8V on 200Ω range
Overload Protection: 500V dc or rms ac on all ranges
Response Time: ≤2 seconds to rated accuracy except ≤8 seconds on mΩ ranges

Continuity

Ranges: All resistance ranges
Threshold: For 8060A, ≤10% of any range used through 200 kΩ range and ≤20 kΩ above 200 kΩ range. For 8062A ≤50% of range and nominally <100 kΩ above 200 kΩ range
Indication: Horizontal bar in display, plus audible tone when desired
Response Time: ≤50 µs continuity, ≥200 ms indication

Diode Test

The diode test function displays the voltage-drop across a simiconductor junction using a 1 mA (± 10%) constant current supply and a 2V range. All resistance ranges up to and including the 200 KΩ range have less than enough source voltage to forward-bias a semiconductor junction, so that they can be used for in-circuit measurements
Reading Accuracy: ±(0.05% + 2 digits) for 8060A, ±(0.06% + 2 digits) for 8062A
Overload Protection: 500V dc or rms ac
Response Time: ≤2 seconds to rated accuracy

Conductance (8060A only)

Range: 200 nS (equivalent to 500 kΩ)
Resolution: 0.1 nS
Accuracy: (0.5% of reading + 20 digits)
Overload Protection: 500V dc or rms ac

Relative Reference

When the REL button is pushed the displayed reading is stored as a reference and subtracted from subsequent readings to indicate the amount of deviation.
Accuracy: Error will not exceed the sum of the errors of the reference reading and subsequent readings

Frequency (8060A only)

Ranges: 200 Hz, 2000Hz,20 kHz, and 200 kHz, automatically selected in the Hz mode, ac voltage function. Measures down to 12 Hz. Will measure to 700 kHz in Extended Frequency Mode
Resolution: 0.005% of range, e.g., 0.01 Hz in 200 Hz range
Accuracy: ±(0.05% of reading + 1 digit)
Input Inpedance: Ac coupled into 10 MΩ, 100 pF
Sensitivity: For sinewaves, ≥10% of voltage range to 20 kHz, ≥25% of voltage range to 100 kHz, ≥75% of voltage range to 200 kHz
Response Time: ≤1 second above 16 Hz, ≤1.3 seconds from 12.2 Hz to 16 Hz, to rated accuracy

General Specifications

Calibration Cycle: One-year for specified accuracy
Display: 4 1/2 digits (20,000 counts), LCD, autozero, autopolarity, low battery (BT) indicator
Max.Common Mode Voltage: 500V dc or rms ac
Temperature: 0°C to 50°C operating; -35°C to 60°C non-operating
Temperature Coefficient: ≤0.1 times the applicable accuracy specification per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤80% to 35°C but ≤70% when measuring reisistance above 20 MΩ
Shock and Vibration: Per MIL-T-28800, Class 5
Safety: UL 1244 listed
Power: Single 9V battery, NEDA 1604, typically 170 hours of operation with alkaline type
Size: 180 mm L x 86 mm W x 45 mm H (7.1 in x 3.4 in x 1.8 in)
Weight: 0.41 kg (0.90 lb)
Included: Manual, TL70 test leads, 9V battery, operator's card, spare fuse

Ordering Information

Models	January 1989 prices
8060A DMM, measures frequency	$389
8062A DMM	329

Accessories (Also see page 127)	
TL20 Test Lead Set	35
TL70 Replacement Test Lead Set	8
Y8132 Test Lead Set	11
Y8134 Deluxe Test Lead Kit	22
Y8140 Test Lead Set	20
C25 Ruggedized Soft Case	20
C90 Soft Carrying Case	15
C100 Universal Carrying Case	30
A81 Battery Eliminator	20
83RF 100 mHz RF Probe	55
85RF 500 mHz RF Probe	85
80TK Termocouple Module	65
80T-150U Temperature Probe	120
80K-6 High Voltage Probe	49
80K-40 High Voltage Probe	85
80J-10 Current Shunt	35
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400 AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600 AC Current Probe	119
80i-1010 Dc/AC Current Probe	229
80i-kW Current/Power Probe	395

Service & Support

Warranty
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)

PM 2518, PM 2618, PM 2718 (Series 18)

PM 2518 PM 2618 PM 2718

Series 18 Handheld Multimeters

- High resolution analog bargraph
- Logic measurements to 10 MHz
- Frequency measurements to 200 kHz
- Min/Max and data hold
- mAs option for medical applications
- Electronic closed case calibration
- 750V ohms protection
- 0.1%, 0.07% and 0.04% basic accuracy with backlight LCD

These Series 18 DMMs are portable and compact, convenient for use in the laboratory or field, with all the performance and features expected of benchtop instruments.

The range of three models allows you to select exactly the functions you need for your application and environment, from general purpose testing, through communications and digital measurements, right up to R&D. Series 18 DMMs offer an excellent combination of value, convenience and performance.

High Accuracy Display

The 4+ digit display permits fast, high resolution measurements to be made on all functions. For example, 5V is measured to the nearest millivolt, with an accuracy of 0.1% or better.

AC True rms Values, Accurate up to 100 kHz

The new Series 18 DMMs have a custom true rms converter that guarantees accurate measurements on all ac signals (AC coupled). The following table compares the readings given for various input waves for the Series 18 meters and standard averaging instruments

Signal Form	∿	⊓	∧	∿
RMS value	5V	5V	5V	5V
Reading on new Series 18 % error	5V 0	5V 0	5V 0	5V 0
Reading on averaging meter % error	5V 0	5.55V 11	4.7V 6	3.2V 36

750V Protection for Reliability

With standard 750V ohms input protection on all except current ranges, these new meters are amongst the best protected handheld instruments against accidental overload.

They can be connected to three-phase power supplies and the function switch can be rotated through the ohms range without damaging the meter.

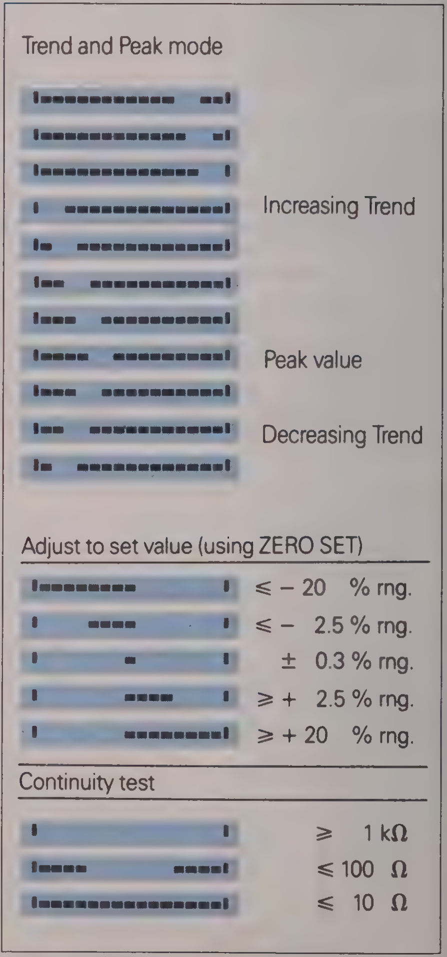
Standard dc and ac voltage range is 1 kV, protected to withstand 2.5 kV spikes, ensuring that these meters are not damaged in tough measuring conditions.

Bargraph Display

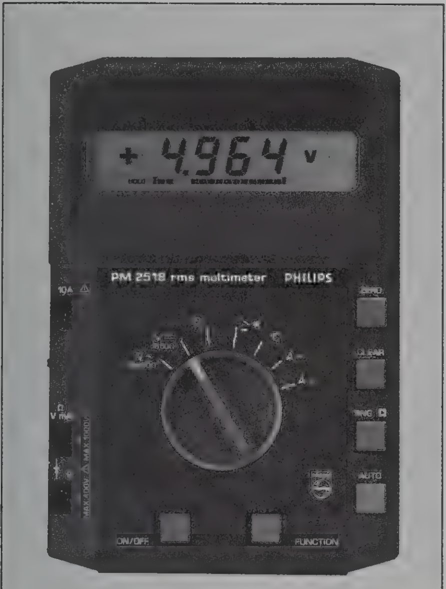
In checking signal trends or looking for peak values, the new Series 18 bargraph display is a step forward over conventional analog pointer systems. For example, as long as the input signal is increasing, the rotating bargraph moves to the right. When autoranging of the digital display value occurs, the bargraph continues to move to the right, always giving a clear indication of the signal trend, even when the signal crosses meter ranges.

For accurate detection of peak values, for example when tuning communication equipment, the bargraph has a maximum resolution equivalent to 8 counts on the digital display, or 0.08% of an analog scale.

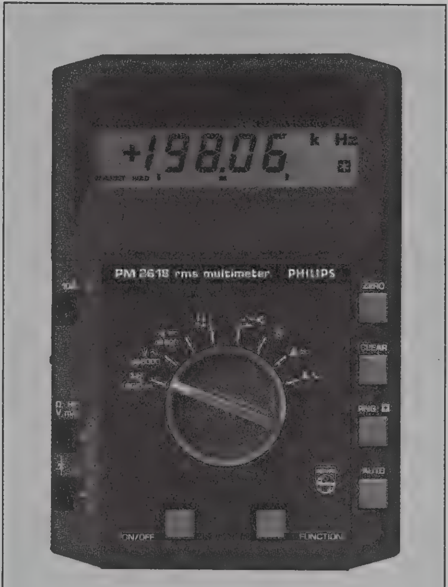
For adjustment to set values, the ZERO SET mode of the new Series 18 meters allows the bargraph to function as a highly sensitive minus-null-plus indicator. This allows accurate analog-indicated settings to any value within the meter's measuring range to an accuracy of 0.3%. Continuity testing not only gives an audible warning, but also a visual indication on the bargraph display.



PM 2518, PM 2618, PM 2718 (Series 18)



PM 2518



PM 2618

PM 2718

PM 2518

- AC True rms (AC coupled)
- 750V ohms protection
- Analog bargraph
- Closed-case calibration
- Relative measurements
- dB measurements
- Temperature measurements
- 0.1% dc accuracy
- 40 kHz range

PM 2618

All PM 2518 features plus ...
- 0.07% dc accuracy
- 70 kHz AC range
- 200 kHz counter
- 10 MHz logic detection
- mAs option

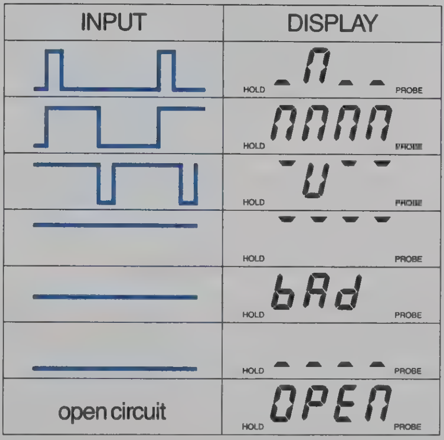
PM 2718

All PM 2618 features plus ...
- 0.04% dc accuracy
- 100 kHz ac range
- Min/Max. measurements
- Data capture and hold

10 MHz LOGIC Detection (PM 2618 and PM 2718 only)

Digital signal activity at speeds of more than 10 MHz can be meaningfully indicated by the LOGIC function. This allows not only high, low, bad or pulsed logic levels to be detected, but also gives an indication of the duty cycle at the measured point. The ability to distinguish between bad levels and real open circuits considerably reduces troubleshooting time.

At 'any logic', compatibility is simply achieved by connecting the measuring leads to the low and Vcc levels in the circuit to be tested, and pressing the ZERO button. The thresholds for the LOGIC mode are then set to 25% (low) and 75% (high) of this value, thereby covering the full range of logic levels — from low-power CMOS to industrial hardwired logic.



mAs Version (PM 2618 only)

Where milliamp second measurements are required, for example in medical environments, a special PM 2618 version allows these to be made in addition to any other standard functions. A single switch allows selection of mA, mAs measure or mAs zero. Measurement of pulses from 0.5 ms to 1 s in the range 10 uAs to 20 As ensures compatibility with current and future X-ray systems and scanners. This special version also includes the backlight display, with automatic on/off switching depending on the ambient light level.

Resistance Measurements from Short Circuit to 100 Mohm

Fast circuit-continuity checks are possible with a beeper that gives an instant warning of short-circuits, while resistance values from 100 mohm to 100 Mohm are displayed clearly and with optimum resolution via the autoranging.

PM 2518, PM 2618, PM 2718 (Series 18)

Function	Meter Ranges	Resolution	Accuracy (% reading = % range)			Input characteristics	Response time	Overload protection	Notes
			PM 2518	PM 2618	PM 2718				
Vdc	1V 10V 100V 1000V	100µV 1mV 10 mV 100 mV	0.1 + 0.02 0.1 + 0.02 0.1 + 0.02 0.1 + 0.02	0.07 + 0.02 0.07 + 0.02 0.07 + 0.02 0.07 + 0.02	0.04 + 0.02 0.04 + 0.02 0.04 + 0.02 0.04 + 0.02	10 MΩ 10 MΩ 9.1 MΩ 9.1 MΩ	Manual < 1s Auto < 1.5S	1000 Vrms 2.5 kV spike	
Vac (ac. coupled, True RMS, crest factor 2)	1V 10V 100V 1000V	100 µV 1 mV 100V 1000V	40 Hz to 3 kHz 0.5 + 0.1 3 kHz-40 kHz per kHz 0.20 + 0.05	40 Hz to 3 kHz 0.4 + 0.1 3 kHz-10 kHz per kHz 0.15 + 0.03	40 Hz to 3 kHz 0.3 + 0.1 3 kHz-100 kHz per kHz 0.1 + 0.03	>2 MΩ <20 pF	Manual <1s Auto <1.5s	1000 Vrms 2.5 kV spike	
Idc	20 mZ 200 mA 2A 10A(20A<20s)	10 µA 100 µA 1 mA 10 mA	0.5 + 0.1 0.5 + 0.1 0.5 + 0.1 0.5 + 0.1	0.4 + 0.1 0.4 + 0.1 0.4 + 0.1 0.4 + 0.1	0.4 + 0.1 0.4 + 0.1 0.4 + 0.1 0.4 + 0.1	<25 mV drop <250 mV drop <25 mV drop <250 mV drop	Manual <1s Auto <1.5s	20 mA and 200 mA ranges fuse protected	Voltage drop excludes fuse on 20 mA and 200 mA ranges
Iac (ac coupled True RMS, crest factor 9)	20 mA 200 mA 2A 10A(20A<20s)	10 µA 100 µA 1 mA 10 mA	0.8 + 0.1 40 Hz-400 Hz	0.8+ 0.1 40 Hz-400 Hz	0.6 + 0.1 40 Hz-400 Hz	Voltage drop as Idc	Manual <1s Auto <2	as Idc	as Idc
R	1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MQ 100 MΩ	100 mΩ 1Ω 10Ω 100 Ω 1 kΩ 100 kΩ	0.3 + 0.1 0.3 + 0.1 0.3 + 0.1 0.3 + 0.1 0.5 + 0.1 5 + 3	0.2 + 0.1 0.2 + 0.1 0.2 + 0.1 0.2 + 0.1 0.4 + 0.1 5 + 3	0.15 + 0.05 0.15 + 0.05 0.15 + 0.05 0.15 + 0.05 0.3 + 0.1 5 + 3	1 mA drive 100 µA drive 10 µA drive 1 µA drive 100 nA drive 10 nA drive	Manual <1s Auto <3s 10s	750V	Open input Voltage 3V 100 MΩ Manual ranging
Hz PM 2618 and PM 2718 only	20 kHz 200 kHz	1 Hz 10 Hz	N.A, N.A.	0.1 + 0.01 0.1 + 00.1	0.1 + 0.01 0.1 + 0.01	≤1 Vpp sensitivity 2 MΩ//3pF			10 Hz lower limit Gate time 1s
°C via Pt 100 100Ω RTD	-250°C to + 1000°C	0.1•C	1°C in range -20 to + 100°C	1°C in range -20 to 100°C	1°C in range -20 to + 100°C	1 mA drive current	dependent on probe		PM 9249 range -60°C to +200°C
Diode Test	1 Vdc	100 µV	0.3 + 0.1	0.3 + 0.1	0.3 + 0.1	1 mA drive	<1s	750V pk	
Continuity Test	1 kΩ	100 MΩ	0.5 + 0.1	0.5 + 0.1	0.5 + 0.1	1 mA drive	<0.2s	750V pk	Beeper
dB Vac	-51 dB to + 43 dB	0.1dB(>100 mV) 1 dB (<100 mV)	as Vac	as Vac	as Vac	Referenced to 1 mW 600Ω	as Vac	as Vac	
dB Vdc	-47 dB to +53.8 dB	0.1 dB(>10 mV) 1 dB (<10 mV)	±0.1dB(>10mV) ±1dB(<10mV)	±0.1dB(>10mV) ±1dB(<10mV)	±0.1dB(>10mV) ±1dB(<10mV)	Referenced to 1 mW 50Ω	as Vdc	as Vdc	1 mW 50Ω

Easy to Read in the Dark

Where measurements have to be made under poor lighting conditions, for example among tightly packed equipment or in out-of-the-way areas, special backlight versions of the new Series 18 DMMs have a display light that switches on automatically. If no new measurement is made, the backlight switches off after a short period to conserve battery life. Complete power-down of the instrument takes place after 30 minutes on both standard and backlit versions. Combined with low power consumption in normal use, this contributes to a battery lifetime of hundreds of hours.

Direct Temperature Readings

The optional PM 9249 Platinum RTD 100 probe gives direct temperature readings from -60 to +200°C, with a resolution of 0.1°C for air, liquid or surface temperatures.

Direct Gain and Loss Measurements

Measurements on amplifiers or communications equipment frequently require the conversion of readings into dB values. This is available with a single button operation on the Series 18, to a resolution of 0.1 dB and eliminating the need for separate calculations.

Relative Reference Values

Measurements of tolerances or component deviations from specified values are simple with the Series 18. A reference relative value can be set using the ZERO button, so the user does not always have to make the measurement relative to zero and calculate the deviation. Measurements are then made automatically, relative to that reference value.

200 kHz Frequency Counter Function (PM 2618, PM 2718 only)

A fully automatic counter function works at frequencies from 1 Hz to 200 kHz. Read-out is direct, with a scale indication showing Hz or kHz. It is highly sensitive, making it suitable for audio applications.

MIN/MAX Read-Out (PM 2718 only)

To monitor minimum and maximum levels in test set-ups, all the user has to do is connect the PM 2718 and leave it to measure. Minimum and maximum readings can be recalled and displayed at any time; and maximum and minimum readings of low-frequency signals (±1Hz) can be measured and read within a few seconds.

Data Capture and Hold

PM 2718's data capture function allows a measured value to be frozen on the display, essential when working in situations where access to the measurement point is difficult. PM 2718 offers this as standard and it is optionally available on all Series 18 instruments with the data hold probe PM 9267. The user simply connects the measuring leads, waits for the "beeper" to confirm that the measurement has been acquired, and it can be read whenever it is needed.

Closed-Case Calibration

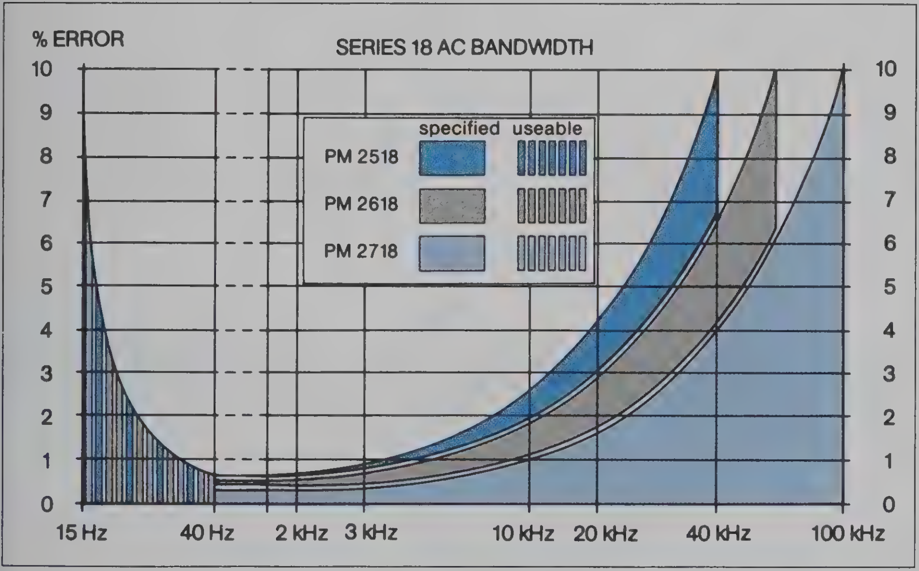
The new Series 18 DMMs are the first compact battery-powered units to offer closed-case calibration, a facility normally found only on much more expensive instruments. This facility allows savings in calibration time and cost and ensures error-free calibration.

The instruments can be recalibrated without opening the case by connection of an appropriate standard and switching the unit to "CAL" mode. For volume users recalibration is possible in an automated system environment. The optional PM 9181 GPIB interface speeds calibration by enabling these meters to be triggered, ranged, read and recalibrated over the IEEE 488 standard bus.

Specifications

General

Display: LCD, 12mm height with range and message characters
ADC System: Delta modulation, auto-zeroing, 11,000 counts
Reading Rate: 2.5 measurements/s
CMMR DC: >100 dB
CMMR 50/60 Hz: >80 dB
SMMR 50/60 Hz: >60 dB
Ranging: Fully automatic except 100 MΩ
Range Selection: Auto-range up at 110% of fs; Auto-range down at 10% of fs; Manual ranging by key
Overload: Indicated by OL on display
Underload (dB): Indicated by UL on display
Crest Factor Overload: Indicated by on display
High Voltage 110V: Indicated by on display
Max. V x Hz: 10^7
Reference Conditions: 23°C ± 2°C, RH 20... 80%, dewpoint 28°C



Logic Function (PM 2618 and PM 2718 only)

Vcc of test unit entered by use of ZERO key on meter
Default Vcc: 3.2V (gives 0.8V and 2.4V)
Logical 0 Level: ≤0.25Vcc
Logical 1 Level: ≥0.75Vcc
Threshold Resolution: ±50mV
Max. Vcc: 100V
Min. Pulse Duration: 100 ns using 1:1 probe
Max Frequency: 10 MHz using 1:1 probe
Beeper Function: On/Off via FUNCTION key; Low tone for logical 0. High tone for logical 1; intermittent high tone for pulse

Relative Measurement (using ZERO button)

Applicable Functions: All
Set Reference: On pushing ZERO button; last displayed value is used as reference
Recall Reference: By pushing and holding ZERO
Clear Reference: By key combination or Auto range selection

BEEPER Functions

PM 2518 and PM 2618: Dual tone selectable for ohms; Low ≤10%, high ≤continuity; Low ≤10%, high ≤1% logic; see logic function
PM 2718: As PM 2618 plus data captured indication

Environmental Conditions

Reference Temperature: 23°C ± 1°C
Rated Range of Use: 0...+45°C
Operating Range of Use: -10...+55°C
Storage & Transport: -40...+70°C
Limits of Humidity for Operation: 20...80%
Max Dew Point: +28°C

Calibration Interval: 1 year
Power Supply: 4 x R14 batteries or PM 9218 A Power Supply Adapter
Power Consumption: /02 versions 45 mW typical; /12 versions 180 mW typical (light on)
Safety: Class II acc. to IEC 348/VDE 0411/UL 1244
Warranty Period: 1 year
Size: 170 mm L x 55 mm W x 188 mm H (6.7 in L x 2.2 in W x 7.4 in H)
Weight: 0.7 kg (1.5 lb)
Included with instruments: PM 9266 safety leads and probes, operating manual, spare fuses

PM 2518, PM 2618, PM 2718 (Series 18)

Ordering Information

Models

	January 1989 prices
PM 2518/023 Standard version	$275
PM 2518/123 Standard version with backlit display	360
PM 2618/023 Extended version	329
PM 2618/123 Extended version with backlit display	409
PM 2618/323 mAs version with backlit display	750
PM 2718/023 High accuracy version	379
PM 2718/123 High accuracy version with backlit display	459

Accessories (Also see page 127)

PM 9101/01 AC/DC Current Clamp	$495
PM 9210 50Ω HF Probe	259
PM 9212 Accessory Kit for PM 9210	220
PM 9213 Low cost HF (100 MHz) Probe	69
PM 9215/50 10MHz Logic View Probe	75
PM 9218A/013 Power Supply	40
PM 9244 30A Shunt	69
PM 9245 100A AC Current Probe	65
PM 9246/03 30 kV Probe	149
PM 9249/01 Pt 100 Temperature Probe	150
PM 9266 /02 Pair of Safety Test Leads	39
PM 9267/01 Data Hold Probe	150
PM 9278/02 Carrying Case	75

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Multimeter Accessories

Today's multimeters can become even more powerful tools through the use of acessories. High voltages and currents can be scaled down to levels that are safe to measure with a digital multimeter (DMM).

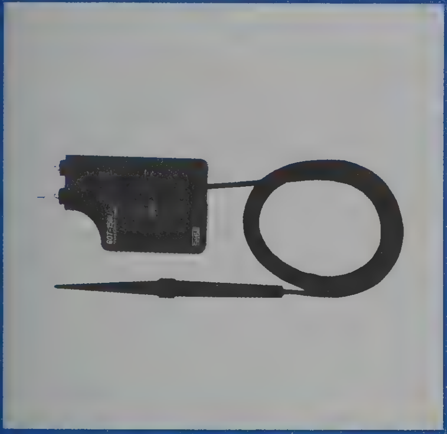
Temperature modules and thermocouple probes can convert a DMM into a thermometer. And high frequency probes allow a DMM to be used in situations that might otherwise require an oscilloscope.

This section includes a wide assortment of carrying cases, test leads and special accessories, too. In total, Fluke and Philips offer more accessories for more digital multimeters than anyone in the world.

Our accessories are unsurpassed in quality of design and workmanship. And, they are compatible with other manufacturers' DMMS.

Page 137 80i-kw

Page 131 C100


Page 132 80T-150U

Page 130 TL20

Page 135 80k-40

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Selection Guide 128
Test Leads & Carrying Cases 130
Frequency, Temperature, High Voltage Probes 132
Current Clamps 136
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Selection Guide 129
Philips Accessories 138

Fluke-Produced Accessories

Fluke-Produced Accessory Selection Guide*

ACCESSORIES		DIGITAL VOLTMETERS and MULTIMETERS																								
		8025B	21	23	25, 27	37	73	75	77	83	85	87	8010A	8012A	8020B	8021B	8024B	8026B	8050A	8060A	8062A	8500 Series	8840 Series	8920A	8921A	8922A
TL20	Test Lead Set	(4)	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	•	•	—	•	—	—	—
TL70	Test Lead Set	•	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	—	—	(4)	(4)	(4)	(4)	(4)	(4)	(4)	—	(4)	—	—	—
Y8131	Test Lead Set	—	—	—	—	—	—	—	—	—	—	—	(4)	(4)	—	—	—	—	—	—	—	•	—	(1)	•	(1)
Y8132	Test Lesd Set	•	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	•	•	—	•	—	—	—
Y8133	Test Lead Set	—	—	—	—	—	—	—	—	—	—	—	•	•	—	—	—	—	—	—	—	•	—	(1)	•	(1)
Y8134	Test Lead Set	•	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	•	•	—	•	—	—	—
Y8140	Test Lead set	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
C20	Hard Case	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C25	Soft Case	—	(6)	(6)	•	—	—	(6)	(6)	(6)	(6)	(6)	—	—	(9)	(9)	(9)	(9)	—	(9)	(9)	—	—	—	—	—
C50	Soft Case	—	•	—	—	—	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C70	Holster	—	•	(4)	—	—	•	•	(4)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C81G	Holster Grey	—	—	—	—	—	—	—	—	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C81Y	Holster Yellow	—	—	—	—	—	—	—	—	(4)	(4)	(4)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C86	Hard Case	—	—	—	—	—	—	—	—	—	—	—	•	•	—	—	—	—	•	—	—	—	—	—	—	—
C90	Soft Case	—	(6)	(6)	—	—	—	(6)	(6)	—	—	—	—	—	•	•	•	•	—	•	•	—	—	—	—	—
C100	Hard Case	(4)	•	•	•	—	•	•	•	•	•	•	—	—	•	•	•	•	—	•	•	—	—	—	—	—
Y8205	Soft Case	—	—	—	—	—	—	—	—	—	—	—	•	•	—	—	—	—	•	—	—	—	—	—	—	—
A81	Battery Eliminator	—	—	—	—	•	—	—	—	—	—	—	—	—	•	•	•	•	—	•	•	—	—	—	—	—
80T-H	Touch-Hold Probe	(5)	—	(5)	(5)	(5)	—	—	(5)	(5)	(5)	(5)	•	•	—	—	—	—	•	—	—	—	—	—	—	—
83RF	R.F. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
85RF	R.F. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
80TK	Temp. Module	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(5)	•	•	•	•	•	•	(1)	•	(1)
80T-150U	Temp. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
80T-SP	Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—
Y8102	Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—
Y8103	Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—
Y8104	Temp. Termination	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—
80K-6	H.V. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
80K-40	H.V. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
80J-10	Current Shunt	(5)	•	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
Y8100	Current Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(8)	(1)	•	(1)
Y8101	Current Probe	•	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(3)	(8)	(3)	(3)	(3)
80i-400	Current Probe	•	(7)	•	•	•	—	•	•	•	•	•	—	—	•	•	•	•	•	•	•	—	(8)	—	—	—
80i-410	Current Probe	•	(10)	(10)	•	•	(10)	(10)	(10)	•	•	•	—	—	•	•	•	•	•	•	•	—	(8)	—	—	—
80i-600	Current Probe	•	(7)	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(3)	(8)	(3)	(3)	(3)
80i-1010	Current Probe	•	(10)	(10)	•	•	•	(10)	(10)	•	•	•	—	—	•	•	•	•	•	•	•	—	(8)	—	—	—
80i-kW	Current/Power Probe	•	(10)	(10)	•	•	•	(10)	(10)	•	•	•	—	—	•	•	•	•	•	•	•	—	(8)	—	—	—
LCA-10	Line Current Test Adapter	•	—	•	•	•	•	•	•	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y9108	BNC Adapter	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	•	—
Y9109	BNC Adapter	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	•

• Means Compatible and recommended

— Not compatible, not recommended, or not applicable

(1) Y9109 Adapter required
(2) On some ranges inputs must be shunted to equal 10 MΩ
(3) Current-measuring option required or A90
(4) Included with DMM
(5) Feature of DMM alone

(6) Accomodates DMM with Holster
(7) Compatible, 320A maximum
(8) Requires ac option for ac current
(9) Loose fit
(10) 1 amp resolution for ac current

**For additional accessories see page 485 (rackmounts, cables, etc...)*

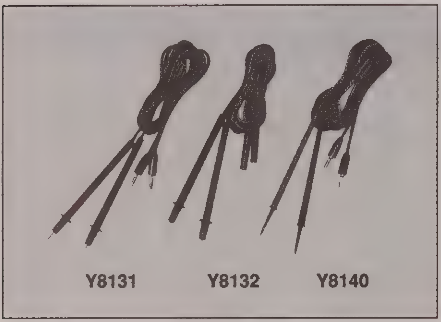
Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Philips-Produced Accessory Selection Guide

Item	Model Number	Description	PM 2504	PM 2505	PM 2518	PM 2618	PM 2718	PM 2518 /02	PM 2618 /02	PM 2718 /02	PM 2519 *	PM 2521 *	PM 2525	PM 2528	PM 2534	PM 2535	PM 2544	PM 2554
Measurement Cables	PM 9071	Banana-Banana 135 Ohm	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	
	PM 9072	Banana-BNC 135 Ohm	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	PM 9074	BNC-BNC 50 Ohm																Δ
Adapters	PM 9051	Adapter BNC-Banana				Δ	Δ											Δ
	PM 9053	Adapter Banana-BNC	Δ		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	
	PM 9061	Adapter BNC-BNC																Δ
	PM 9067	T-Piece BNC																Δ
Test Leads	PM 9260/00	Pair of Test Leads	•	•									Δ					
	PM 9266/02	Pair of Safety Test Leads			•	•	•	•	•	•	•	•	•	•	•	•	•	
	PM 9264/01	4-Wire Test Leads											Δ	Δ	Δ	Δ		
	PM 9265/01	Measuring Cable												Δ	Δ	Δ		
	PM 8924/00	1:1 Passive Probe																Δ
	PM 8926	10:1 Passive Probe																Δ
	PM 9263/01	Hold Probe										Δ		Δ				
	PM 9267/01	Hold Probe			Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ		Δ	Δ		
	PM 9215/50	Logic View Probe				Δ	Δ		Δ	Δ								
HF Accessories	PM 9258/01	HF Option												Δ				
	PM 9210	HF Probe	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	
	PM 9211/00	HF Probe Set (Linear)												Δ				
	PM 9212	Accessory Set for PM 9210	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	
	PM 9213	Low cost HF Probe	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	
HT Probe	PM 9246/03	30 kV Probe	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	
Peak Voltage	PM 9259/01	Peak Voltage Option												Δ				
Temp. Probes	PM 9249/01	Temperature Probe			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		
Current Accessories	PM 9244	30A Shunt	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	PM 9245	100A Transformer	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	
Power Line Adaptors	PM 9218A/013	Power Line	Δ		Δ	Δ	Δ	Δ	Δ	Δ								
	PM 9111/01	Power Line (220V)		Δ														
Carrying Cases	PM 9278/02	Ever-Ready Case		Δ	Δ	Δ	Δ	Δ	Δ	Δ								
	PM 9279/01	Carrying Case									Δ	Δ					Δ	
Rack Mount	PM 9280/02	(2E High) 19" Rack Mount Kit													Δ	Δ		
	PM 9669/03	Rack Mount Unit												Δ				
	PM 2193/01	3E Rackmount Kit											Δ					
	PM 9606/00	Rackmount Kit													Δ	Δ		
Interfaces	PM 9292/02	BCD Output												Δ				
	PM 9191/02	Bus-Line Interface									Δ							
	PM 9291/02	Bus-Line Interface												Δ				
	PM 9254/02	Analog Output												Δ				
Linearizers	PM 9877 J/2	Thermocouple Module J-type											Δ					
	PM 9877 K/2	Thermocouple Module K-type											Δ					

*•Included in delivery ΔOptional *No longer available*

Fluke-Produced Accessories



Y8131 Test Lead Set $11

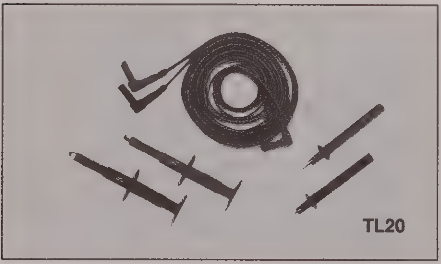
Four-foot test leads feature exposed banana plugs on one end and detachable probes with solid pin tips and finger guards on other end. Compatible with Y9134 Alligator Clips. See Selection Guide for compatible DMMs.

Y8132 Test Lead Set $11

Same as Y8131 except safety designed banana plugs are shrouded by an insulating shield. See Selection Guide for compatible DMMs.

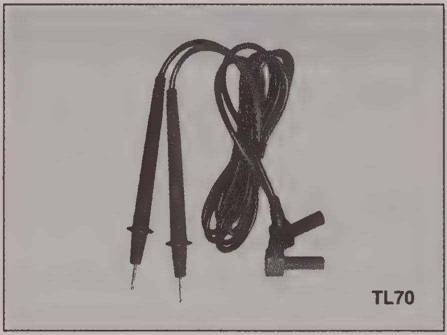
Y8140 Test Lead Set $20

Slim, retractable, insulated, needle-point tips adjust to desired length. Tough, thin insulation extends all the way to the points to prevent shorting adjacent components or conductors. Needle points easily pierce varnish and thin insulation to give good electrical contact. Four-feet long. See Selection Guide for compatible DMMs.



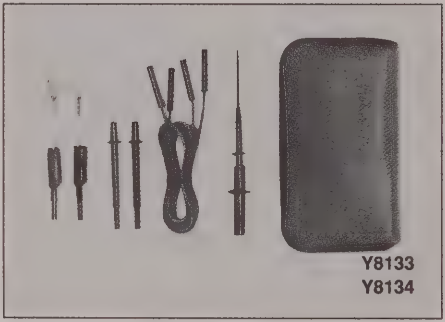
TL20 Test Lead Set $35

Sixty-three inch silicon insulated test leads that remain flexible from -100°C to 300°C (-148°F to 572 °F). Leads have shrouded right-angle connections. Interchangeable stainless steel test probes and sagety alligator clips. See Selection Guide for compatible DMMs.



TL70 Test Lead Set $8

Safety-designed right angle plugs shrouded by insulating shield. Strain relief where wire joins probes 53-inches long. Compatible with AC90 Alligator Clips. See Selection Guide for compatible DMMs.



Y8133 Test Lead Kit $22

Y8133 includes a black and a red insulated wire lead each having an exposed banana plug on one end and a safety-designed, shrouded banana plug on the other. Leads have strain relief for long life. Also included are two insulated alligator clips, two spade lug tips, a spring-loaded hook tip, and two probes with solid metal pin tips, finger guards, and pouch. Any of the clips, tips, and probes may be plugged onto the shrouded banana plug on either wire lead. See Selection Guide for compatible DMMs.

Y8134 Test Lead Kit (Shown) $22

Same as Y8133 Test Lead Kit except banana plugs are shrouded by an insulating shield on both ends of each lead. See Selection Guide for compatible DMMs.

Y9134 Alligator Clips $17

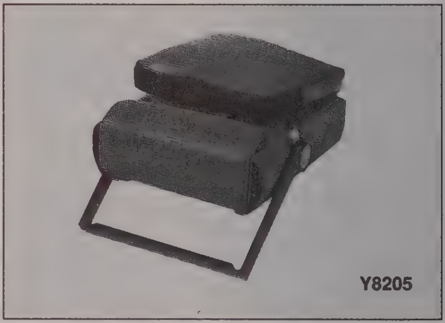
Package of ten insulated alligator clips with banana jack. Five red and five black. For Y8131 through Y8134.

Y9104 Alligator Clips $12

Package of six black slip-on insulated alligator clips for ground connections. Compatible with pin-tip size probes except TL70.

AC70 Alligator Clips $5

Package of four slip-on, insulated alligator clips. Two red and two black. Compatible with TL70 or other pin-tip size probes.



Y8205 Soft Carrying Case $35

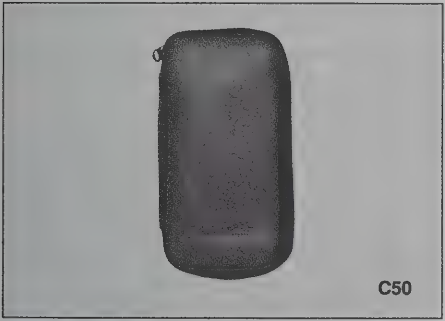
A soft vinyl plastic case designed for the storage and transport of either an 8000A, 8010A, 8012A, 8050A, 2165A, 2166A, 2168A, 2175A, 2176A, or 8600A DMM. A separate storage compartment is provided for test leads and other compact accessories.

Fluke-Produced Accessories

C25

C25 Soft Carrying Case $16

Thickly padded vinyl with tough exterior and interior and heavy-duty water resistant zipper. Holds DMM and test leads. Includes combination belt loop/carrying strap and two storage pockets. For Fluke 25/27 and 8025A. Also accomodates small accessories and Fluke 21, 23, 73, 75, 77 Meters in C70 holster.



C50

C50 Soft Carrying Case $13

A soft, zippered vinyl case for Fluke 21, 23, 73, 75, 77 Multimeters when not in C70 Holster. Includes pocket for test leads. Use C25 with holster.

C90

C90 Soft Carrying Case $13

Constructed of double-wall, fabric-backed vinyl with padded interior and zippered closure for complete protection. Inside pocket holds test leads and operator's instruction card. Carrying strap doubles as belt loop holder. Accommodates 20 and 70 Series DMMs in C70 Holster. For all Fluke handhelds except 25 and 27 DMMs.

C20

C20 Hard Carrying Case $20

The C20 is a heavy duty hard case made of shock resistant polypropylene. A carrying handle, operator's guide decal, and storage compartment for test leads and other small items is included. The cover is secured by two latches that also latch the case top to the back of the case for convenient storage and to form a tilt-up stand. For Fluke 25/27 and included with Fluke 8025A.

C86

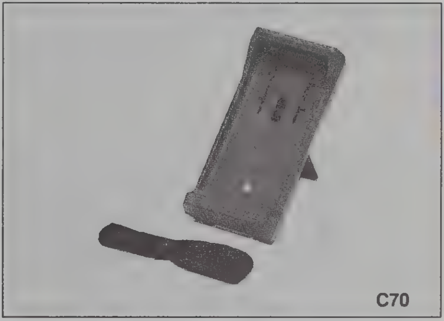
C86 Hard Carrying Case $20

The Model C86 Carrying Case is a molded polyethylene container designed for either an 8010A, 8012A, 8000A, 8050A, or 8600A DMM. This rugged case provides the DMM with maximum protection against rough handling and adverse weather conditions. A separate storage compartment is provided for test leads and other compact accessories.

C100

C100 Hard Carrying Case $30

A tough, polypropylene case that provides protection against rough handling and bad weather. Will also hold 80i-600, 80i-400 or Y8101 Current Probes and smaller accessories. Resembles C86. See Selection Guide for compatible Handheld Multimeters.



C70

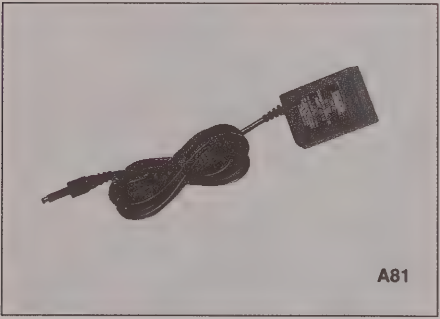
C70 Multipurpose Holster $10

The C70 is for Fluke 21, 73 and 75 Multimeters and is included with the Fluke 23 and 77 models. It is made of a tough semiflexible plastic that snaps over the instrument to absorb shocks and protect the meter from rough handling. The holster also doubles as a tilt stand and includes a belt clip. Holster stores test leads and probes. Probes may be snapped into holster so only one hand is needed to hold both the meter and probe tip in contact with test point.

Fluke-Produced Accessories

C81G/C81Y $14

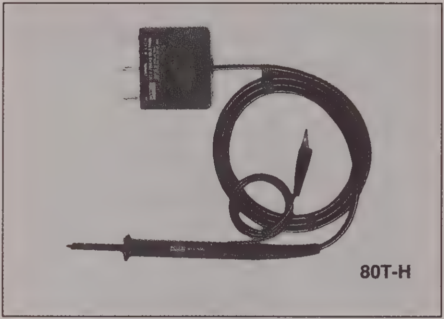
The C81G and C81Y fit Fluke 80 series multimeters. Yellow version (C81Y) is included with multimeter. Gray version (C81G) is optional. Made from durable semiflexible plastic, the C81 holster snaps in place around the multimeter to protect it form rough handling. Flexible rear stand/bail has multiple uses including tilt stand, belt loop, pipe hook etc... Holster stores test leads and probes. Probes may be snapped into holster so only one hand is needed to hold both the meter and probe tip in contact with test point.



A81 Battery Eliminator $20

The A81 provides line operation for DMMs without discharging their disposable batteries. Available in three line voltage versions. Specify version desired. See Selection Guide for compatible DMMs.

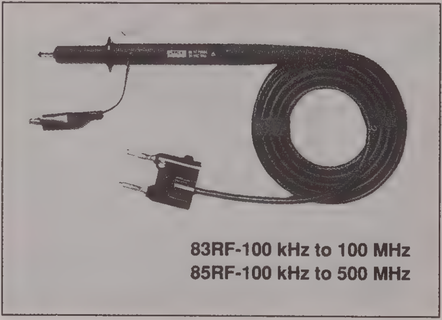
A81-115 115V input (U.S. plug)
A81-230 230V input (European plug)
A81-100 100V input (U.S. plug)



80T-H Touch-Hold Probe $59

The 80T-H is a direct signal-through test probe with a touch and hold feature. Touch-and-hold allows voltage or resistance readings to be held on a digital multimeter display following contact of the probe tip with the test point. Operator can devote full attention to manipulating the probe until the measurement is complete, then remove the probe and observe the reading on the DMM. Activation of a pushbutton on the probe causes the DMM to hold the last number displayed until the pushbutton is released. Works with 8010A, 8012A, 8050A only.

Voltage Rating:
Tip to Common: 1000V dc or peak ac maximum
Common to Ground: 60V dc or 42V peak ac maximum
Input Capacitance: 150 pF maximum
Lead Resistance: 0.58Ω maximum



83RF-100 kHz to 100 MHz
85RF-100 kHz to 500 MHz

83RF High Frequency Probe $55

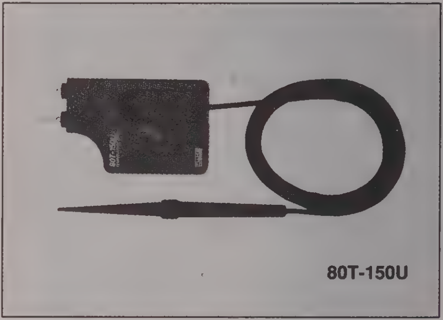
The 83RF converts a 10 megohm input resistance dc voltmeter into a high frequency, 100 kHz to 100 MHz, ac voltmeter. Conversion from ac to dc is on a one-to-one basis over a range of 0.25 to 30V rms. The probe's dc output is calibrated to be equivalent to the rms value of a sinewave input.

AC-to-DC Ratio: 1:1
Ratio Accuracy: ±1 dB above 1V; ±1.5 dB below 1V (at 1 MHz with 10 MΩ load)
Frequency Response: ±1 dB 100 kHz to 100 MHz (relative to 1 MHz)
Extended Frequency Response: Relative readings from 20 kHz to 250 MHz
Response: Responds to peak value of input; calibrated to read rms value of a sinewave
Voltage Range: 0.25 to 30V rms
Maximum Input Voltage: 30V rms, 200V dc
Input Capacitance: Approximately 3 pF

85RF High Frequency Probe $85

The 85RF is designed to convert a 10 megohm input resistance dc voltmeter into a high frequency, 100 kHz to 500 MHz, ac voltmeter. Ac to dc conversion ratio is one-to-one over a range of 0.25 to 30V rms. The probes dc output is calibrated to the rms value of a sinewave input.

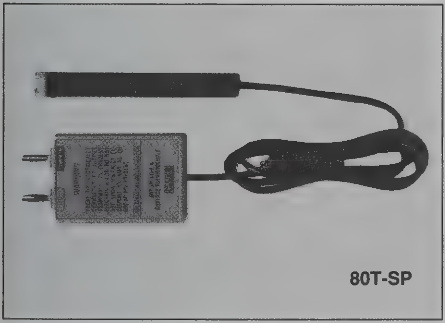
AC-to-DC Ratio: 1:1
Ratio Accuracy: ±0.5 dB above 0.5V (at 1 MHz with 10 MΩ load) ±1 dB below 0.5V
Frequency Response: ±0.5 dB 100 kHz to 100 MHz; ±1.0 dB 100 MHz to 200 MHz;* ±3.0 dB 200 MHz to 500 MHz* (relative to 1 MHz)
Extended Frequency Response: Relative readings from 20 kHz to 700 MHz
Response: Responds to peak value of input; calibrated to read rms value of a sinewave
Voltage Range: 0.25 to 30V rms
Maximum Input Voltage: 30V rms, 200V dc
Input Capacitance: Approximately 3 pF
**Referred to high and low inputs at probe tip*



80T-150U Temperature Probe $120

The 80T-150 is a universal temperature probe designed to provide virtually all DMMs with temperature measuring capability. Intended for air, surface, and non-corrosive liquids, the probe provides direct temperature conversion of 1 mV dc per degree. A three-position switch on the unit acts as a power switch and is used for selecting Celsius or Fahrenheit scaling for the output. In addition, the OFF position of the power switch allows the battery condition to be determined via the external DMM. Operating power for the 80T-150U is derived from a standard 9 volt battery. Typically, the battery provides more than 1600 hours of continuous operation before replacement is necessary. An outstanding feature of particular importance to electronically-oriented users is the probe's ability to stand off voltages to 350V dc or peak ac. This allows voltages to be present on devices whose temperature is being measured. Resolution is 0.1° on the 200 mV range of a 3-digit DMM. Most accurate DMM temperature probe System.

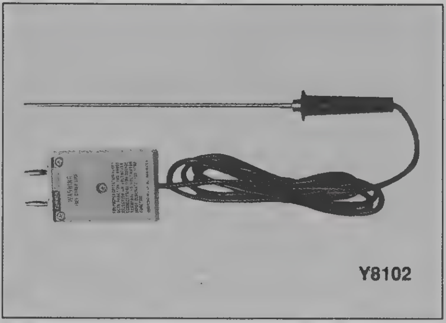
Temperature Range: -50°C to +150°C or -58°F to +302°F, cable 70°C maximum
Celsius-Fahrenheit Selection: Switch selected
Sensitivity: 1 mV per °C or °F
Resolution: 0.1°C or 0.1°F recommended maximum
Ambient Temperature Range for Unit: 0°C to +50°C
Relative Humidity: 90%, non-condensing from 0°C to 35°C
Accuracy: (Including nominal 0.25% voltmeter error, in +15°C to +35°C ambient)
±1°C (1.8°F) 0°C to 100°C, decreasing linearly to ±3°C (5.4°F) at -50°C and +150°C


80T-SP

80T-SP Type K Surface Thermocouple $95

For use with 8024A and 8024B for measuring the temperature of flat or slightly convex surfaces.

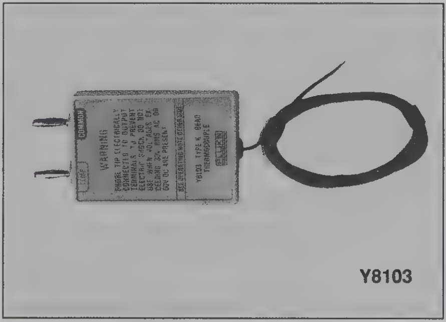
Time Constant: 4 seconds typical on metal surface; 15 seconds max for a 260°C change
Range: 0°C to 260°C, handle and cable 105°C maximum
Accuracy: ±2.2°C from 0°C to 260°C (with respect to NBS thermocouple tables). Also depends on good contact between the tip and the surface to be measured.
Probe Diameter: 12.5 mm (.5 in)
Probe Length: 9.4 cm (3.75 in)
Conductor Length: 1.12m (48 in)


Y8102

Y8102 Type K Thermocouple Probe $62

Designed for use with Fluke 8024A and 8024B Digital Voltmeter. Sheath material is Inconel, especially good for liquid immersion measurements.

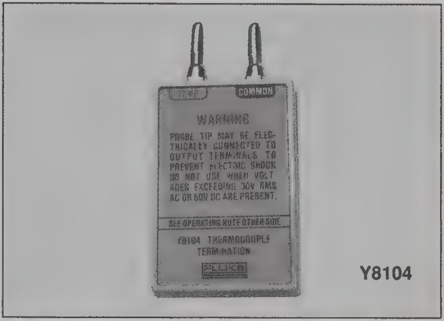
Time Constant: 10 seconds, for air at room temperature and one atmosphere of pressure moving 65 feet per second
Temperature Range: 0°C to 926°C (32°F to 1700°F)
Accuracy: ±2.2°C from 0°C to 276.7°C and ±0.75% of reading from 276.7°C to 926°C
Probe Diameter: 3.18 mm (0.125 inch)
Probe Length: 15.2 cm (6 inches)
Conductor Length: 1.12 meters (48 inches)


Y8103

Y8103 Type K Bead Thermocouple $26

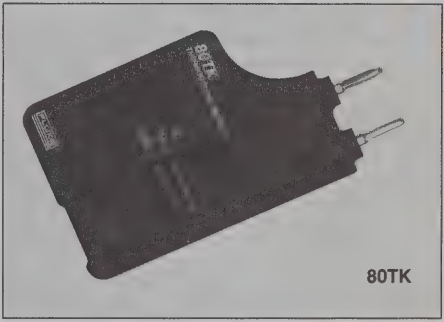
For use with 8024A and 8024B in any application except liquid immersion or penetration. Exposed tip provides fast response. Teflon insulation. Four feet.

Time Constant: 2 seconds, for air at room temperature and one atmosphere of pressure moving 65 feet per second
Temperature Range: 0°C to +260°C (32°F to +500°F)
Accuracy: ±2.2°C from 0°C to +260°C
Useable Range: To -40°C (-40°F)


COMMON
WARNING
PROBE TIP MAY BE ELECTRICALLY CONNECTED TO OUTPUT TERMINALS. TO PREVENT ELECTRIC SHOCK DO NOT USE WHEN VOLTAGES EXCEEDING 30V RMS AC OR 60V DC ARE PRESENT.
SEE OPERATING NOTE OTHER SIDE
Y8104 THERMOCOUPLE TERMINATION
FLUKE
Y8104

Y8104 Thermocouple Termination $11

The Model Y8104 Thermocouple Termination provides isothermal termination for any Type K thermocouple wire connected to 8024A and 8024B. The isothermal nature of the Y8104 ensures that there is no temperature difference between the junctions created by the instrument and the connection of the thermocouple to the terminals. Maximum wire size is #14 AWG.



80TK

80TK Thermocouple Module $65

The Fluke 80TK Thermocouple Module is a low cost temperature measurement accessory designed to work with any digital multimeter. It converts the microvolt output from a "K" type thermocouple into a 1 millivolt per degree signal.

The on-off switch allows selection of degrees "C" or "F" output scaling. Input is via a "mini" thermocouple connector, with provision inside for hardwiring. **A bead thermocouple, with miniconnector attached, is included with the 80TK.** Immersion probes and surface probes are also available, as are additional bead probes.

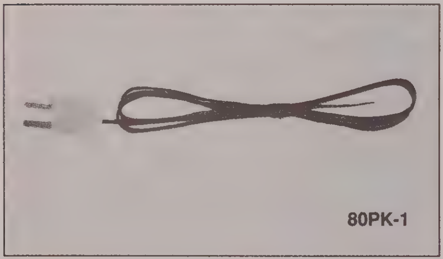
The output of the 80TK may be read on any DMM having 10 Mohm or greater input impedance and a 3-digit display. It is powered by a standard 9V battery, with a typical operating life

Fluke-Produced Accessories

of 1600 hours. Battery condition can be checked on the DMM with battery test instructions printed on the 80TK.

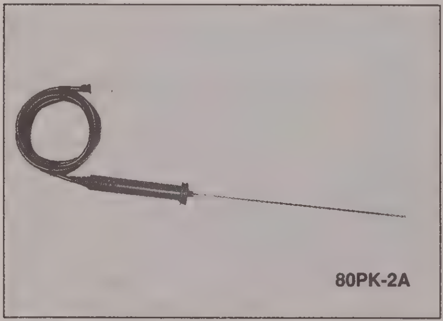
Measurement Range: -50°C to 1000°C (-58°F to 1832°F)
Ambient Operating Range: 0°C to 50°C, 32°F to 122°F
Accuracy:

-50°C to -20°C 2.5% ±2°C -58°F to -5.8°F 2.5±3.6°F	350°C to 500°C 1.75% ±2°C 665°F to 932°F 1.75% ±3.6°F
-20°C to 350°C 0.5% ±2°C -4°F to 662°F 0.5% ±3.6°F	500°C to 1000°C 2.0%±2°C 933°F to 1832°F 2.0%±3.6°F


80PK-1

80PK-1 K-Type Bead Probe $12

Accuracy: (with respect to NBS tables): +1.1°C (2.0°F) over the range of 0°C to 260°C (32°F to 500°F). Typically within 1.1°C of NBS tables over the range of -40°C to 0°C (-40°F to 32°F)
Restrictions: Must be used in Teflon-compatible environments and is not suitable for liquid immersion. The 260°C (500°F) continuous temperature rating is primarily determined by the Teflon insulation.

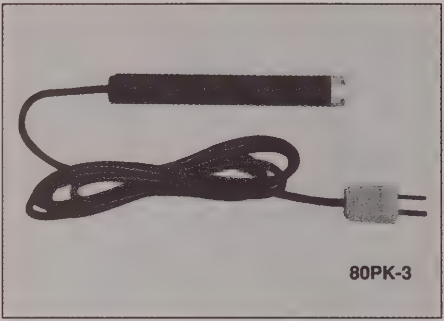

80PK-2A

80PK-2A K-Type Immersion Probe $36

Accuracy: (with respect to NBS tables)

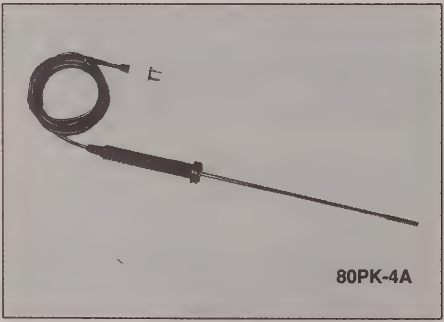
Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±4% of Rdg
-110°C to -40°C (-166°F to -40°F)	±4.4°C (4°F)
-40°C to 275°C (-40°F to 527°F)	±2.2°C (2°F)
275°C to 1090°C (559°F to 1922°F)	±.0.4% of Rdg

Restrictions: The sheath material of the 80PK-2A is Inconel. It should not be used in the presence of sulfur above 537°C (1000°F).


80PK-3

80PK-3 K-Type Surface Probe $69

Accuracy: (with respect to NBS tables): +1.1°C (2.0°F) over the range of -28°C to +260°C (-18.4°F to 500°F)
Restrictions: The 260°C continuous temperature rating is primarily determined by the Teflon support piece. The Teflon insulation should not be exposed to temperatures exceeding 260°C (500°F) nor to open flame, since this can cause release of toxic material.

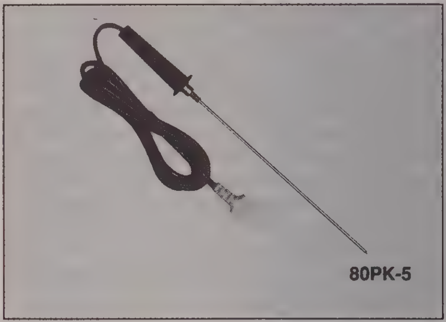

80PK-4A

80PK-4A K-Type Air Probe $49

Accuracy: (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±2% of Rdg
-110°C to -40°C (-166°F to -40°F)	±2.2°C (4°F)
-40°C to 275°C (-40°F to 527°F)	±1.1°C (2°F)
275°C to 816°C (559°F to 1598°F)	±0.4% of Rdg

Restrictions: The 304 stainless steel baffle should not be exposed to halides or sulfides.


80PK-5

80PK-5 K-Type Piercing Probe $36

Accuracy: (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±2% of Rdg
-110°C to -40°C (-166°F to -40°F)	±2.2°C (4°F)
-40°C to 275°C (-40°F to 527°F)	±1.1°C (2°F)
275°C to 816°C (559°F to 1500°F)	±0.4% of Rdg

Restrictions: The sheath material of the 80PK-5 is 316 stainless steel. It should not be exposed to halides or sulfides.

80PK-6A

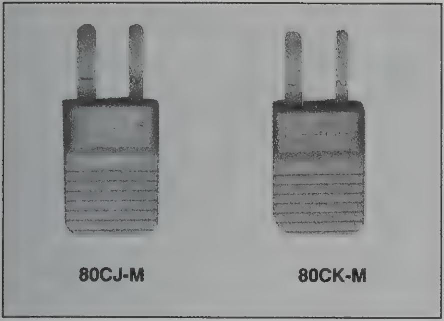
80PK-6A K-Type Exposed Junction Probe $43

Accuracy: (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±2% of Rdg
-110°C to -40°C (-166°F to -40°F)	±2.2°C (4°F)
-40°C to 275°C (-40°F to 527°F)	±1.1°C (2°F)
275°C to 870°C (559°F to 1598°F)	±0.4% of Rdg

Restrictions: The sheath material is 304 stainless steel. It should not be exposed to halides or sulfides. In addition, the probe should not be used in reducing atmospheres or a vacuum.*

**Because of the open access to the inside of the sheath via the exposed bead, the probe must not be immersed in liquid or saturated vapor. Immersion of the probe in liquid or saturated vapor could result in "wicking" of the substance, and possible corrosion.*



80CJ-M Male Mini Connector $7

Package of two male black mini-connectors (20 guage max.) for use with Fluke 50 Series. Isothermal screw terminals for attachment of J-type thermocouple wire.

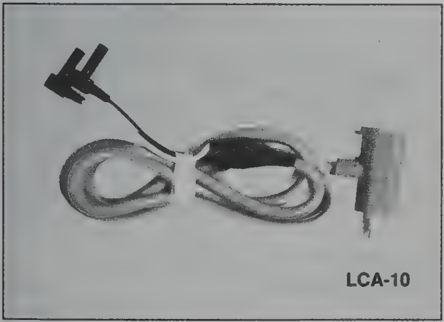
80CK-M Male Mini-Connector $7

Package of two male mini-connectors for use with Fluke 80TK or Fluke 50 Series. Isothermal screw terminals for attachment of K-type thermocouple wire.

Fuses

Fuse-2A 2A/250V fuse, 5 ea.
Fuse-3A 3A/600V fuse, 1 ea.
Fuse-20A 20A/600V fuse, 1 ea.
Fuse-630 mA 630 mA/250V sand-filled, 5 ea

These fuses are provided to ensure proper protection for Fluke DMMs. These are the only fuses that should be used.

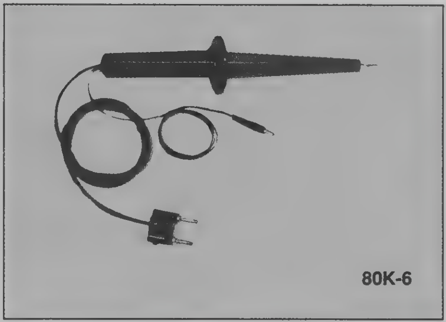


LCA-10 Line Current Test Adapter $13

The LCA-10 Line Current Test Adapter is a low-cost multimeter accessory that allows you to quickly and accurately measure the amount of current used by 120V ac line-powered devices.

The LCA-10 looks similar to an extension cord except that one end has Fluke-compatible safety-designed shrouded banana plugs. These plugs connect the LCA-10 to the high current input (typically 10A) of your multimeter. Inserting the banana plugs into the multimeter places the 120V ac live wire in series with the multimeter current shunt. The other end of the cord plugs into a 120V ac receptacle. The device being measured plugs into the LCA-10 receptacle.

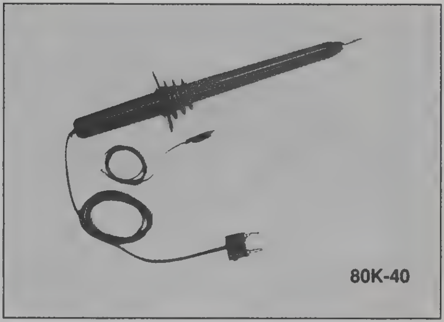
Plug and Receptacle: U.S. NEMA 5-15 compatible (3 wire, straight blade, 15A, 125V ac)
Output Connections: Safety-designed shrouded banana plugs
Maximum Current: 10A ac continuous, 20A ac for 30 seconds
Wire: 5 feet of 16 gauge SJT



80K-6 High Voltage Probe $49

The 80K-6 extends the voltage measuring capability of an ac/dc voltmeter up to 6000 volts. A 1000:1 voltage divider provides a high input impedance. High accuracy is provided when the divider is used with a voltmeter having a 10 MΩ input impedance. A molded plastic body houses the divider and protects user from voltage being measured.

Voltage Range: 0 to 6 kV, dc or peak ac
Input Impedance: 75 MΩ, nominal
Division Ratio: 1000:1
Accuracy:
DC to 500 Hz: ±1%
500 Hz to 1 kHz: ±2%
Above 1 kHz: Output reading falls; typically, -30% at 10 kHz
DVM Compatibility: The 80K-6 achieves rated accuracy when used with an ac/dc voltmeter having 0.25% accuracy, or better, and an input impedance of 10 MΩ ±10%.
Caution: These probes are not intended for electric utility applications in which high voltage is also accompanied by high energy. They are also not intended for use on 3 phase line-to-line measurements. Rather, they are intended for use in lower energy applications such as television and CRT troubleshooting.

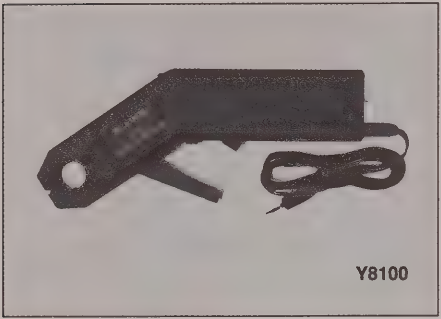


80K-40 High Voltage Probe $85

The Model 80K-40 is a high voltage accessory probe designed to extend the voltage measuring capability of an ac/dc voltmeter up to 40,000 volts. In essence the probe is a precision 1000:1 voltage divider formed by two matched metal-film resistors. The unusually high input impedance offered by these resistors minimizes circuit loading and optimizes measurement accuracy. A special plastic body houses the divider and provides the user with isolation and protection from the voltage being measured.

Voltage Range: 1 kV to 40 kV dc or peak ac, 28 kV rms ac
Input Resistance: 1000 MΩ
Division Ratio: 1000:1
DC Accuracy: ±2% from 20 kV to 30 kV (calibrated 1% at 25 kV); changes linearly from 2% at 30 kV to 4% at 40 kV and from 2% at 20 kV to 4% at 1 kV
AC Accuracy: ±5% at 60 Hz
DVM Compatibility: The 80K-40 achieves rated accuracy when used with an ac/dc voltmeter having 0.25% accuracy, or better, and an input impedance of 10 MΩ ±10%.
Caution: These probes are not intended for electrical utility applications in which high voltage is also accompanied by high energy. They are also not intended for use on 3 phase line-to-line measurements. Rather, they are intended for use in lower energy applications such as television and CRT troubleshooting.

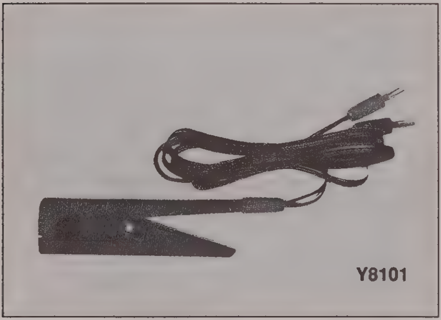
Fluke-Produced Accessories


Y8100

Y8100 Clamp-on DC or AC Current Probe $259

The Model Y8100 is a clamp-on, Hall-effect probe that can be used with a voltmeter, multimeter, or oscilloscope to read dc, ac, or composite (ac/dc) current measurements. The pistol shape allows safe, easy, one-hand operation when making current measurements. Two ranges, 20A and 200A, produce a 2V output at full range current. The probe battery-low indicator light lets the operator know when the battery voltage is too low for proper operation.

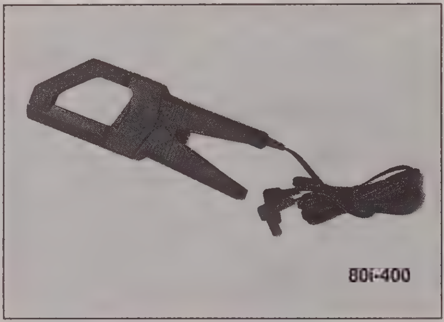
Ranges: 20A ac or dc and 200A ac or dc
Accuracy:
DC to 200 Hz: ±2% of range
200 Hz to 1 KHz: 1-100A add ±3% of reading;
200 Hz to 1 KHz: 2-100A add ±6% of reading
Working Voltage: Core to output; 600V dc or 480V ac maximum. Output to ground; 42V dc or 30V ac maximum
Maximum Conductor Size: 1.9 cm (.75 in)


Y8101

Y8101 Clamp-on AC Current Probe $69

The Y8101 is a small clamp-on current trans former designed to extend the current measuring capability of a DMM or ac current meter up to 150 amperes. The coil on the clamp-on core serves as the secondary of a 1000:1 ratio transformer. The current-carrying conductor being measured serves as the primary.

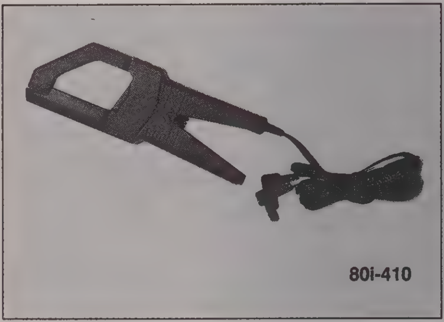
Current Range: 1A to 150A
Accuracy:
48 Hz to 440 Hz ±(2.5% of reading +0.15A);
440 Hz to 1200 Hz ±(3% of reading +0.15A)
Division Ratio: 1000:1
Working Voltage: 300V ac rms maximum
Maximum Conductor Size: 1.11 cm (0.43 in)
Usable Current Range: 0.1A to 200A, 5 seconds maximum above 150A


80i-400

80i-400 Clamp-on AC Current Probe $69

The Model 80i-400 is a clamp-on current probe designed to extend the current capability of an ac current meter to 400 amperes. A clamp-on, 1000-turn coil designed into the probe allows measurements to be made without breaking the circuit under test. The current carrying conductor being measured serves as the primary. The unique shape of the 80i-400 jaw will accommodate a single 750 MCM THHN (30mm diameter) conductor or two 500 MCM THHN (25mm diameter each) conductors run in parallel.

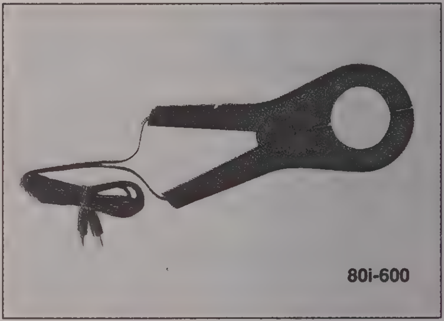
Current Range: 1A to 400A
Accuracy:
±(3% of reading +0.4A) 48 Hz to 440 Hz
±(4% of reading +0.4A) 440 Hz to 1000 Hz
Division Ratio: 1000:1
Working Voltage: 660V ac rms maximum
Maximum Conductor Size: 1 each 30mm (1.18 in) or 2 each 25mm (0.98 in)
Usable Current Range: 0.1A to 600A, 5 seconds maximum above 400A


80i-410

80i-410 Clamp-on DC/AC Current Probe $129

The Model 80i-410 ac/dc current probe extends the ac or dc capacity to 400 amps. This Hall-effect probe is relatively insensitive to conductor position within the jaws for good repeatability. Physical dimensions are identical to 80i-400 and will accommodate similar conductors. Out put signal 1 mV per amp.

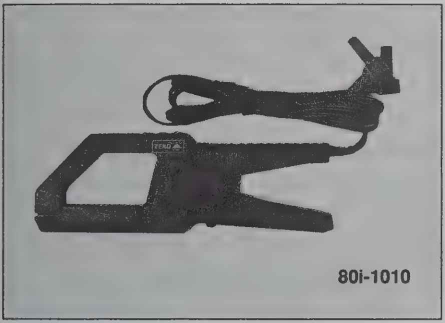
Specified Current Range: 5A to 400A ac or dc
Usable Current Range: 2A to 600A ac or dc
Accuracy: ±(5% + 2.5A) dc to 62 Hz
Working Voltage: 660V rms
Maximum Conductor Size: 1 ea 30mm (1.18 in) or 2 ea 25mm (0.98 in)


80i-600

80i-600 Clamp-on AC Current Probe $119

The Model 80i-600 is a clamp-on current transformer designed to extend the current measuring capability of a DMM or current meter to 600 amperes. A coil on the clamp-on transformer core allows measurements to be made without breaking the circuit under test. This coil serves as the secondary of a 1000:1 transformer. The current-carrying conductor being measured serves as the primary. Because of a high efficiency, evenly distributed winding, wire size and location of the wire within the transformer jaws will not affect the accuracy of current measurements.

Current Range: 1A to 600A
Accuracy:
±(2% of reading) 50 Hz to 1 kHz
±(3% of reading) typical 30 Hz to 50 Hz or 1 kHz to 10 kHz
Division Ratio: 1000:1
Working Voltage: 750V ac rms maximum
Maximum Conductor Size: 5 cm (2 in)
Usable Current Range: 0.1A to 2000A, 5 seconds maximum above 600A


80i-1010

80i-1010 Clamp-on DC/AC Current Probe $229

The 80i-600 is a battery powered clamp-on current probe that is used with a voltmeter to measure dc currents up to 1000 amps or ac currents up to 700 amps. The jaws will accommodate a single 750 MCM THHN or two 500 MCM THHN conductors. A convenient thumbwheel ZERO control improves accuracy of dc currents down to 1 amp. Typical frequency response is -3 dB at 6 kHz.

Specified Current Range: 1 to 1000A dc, 1 to 700A ac
Accuracy: (% of reading)

	dc	ac, 48 to 62 Hz	ac, 62 to 440 Hz
1 to 100A	2% + 1A	2% + 1A	3% + 1A
100 to 700A	3%	3%	5%
700 to 1000A	5%	Not specified	

Output Signal: 1 mV per amp dc or ac
Working Voltage: 660V rms maximum
Maximum Conductor Size: 1 each 30mm (1.18 in) or 2 each 25 mm (0.98 in)

80i-kW

80i-kW Current/Power Probe $395

The 80i-kW Current/Power Probe is a battery powered clamp-on probe. Used with a voltmeter to measure dc current from 1 to 1300 amps, ac current form 1 to 1000 amps and ac power from .5 to 330kW. Includes carrying case, test leads and manual with instructions for measuring power and finding power factor for single phase and three phase circuits. Compatible with multimeters that accept Fluke safety designed shrouded test leads.

Basic Accuracy:
± (2% + 2 amps) for current
± (3.5% + .5kW) for power
Jaw Size: 60 mm (2 3/8 in) x 73 mm (2 7/8)

80J-10 Current Shunt $35

An inexpensive, simple-to-use accessory that lets you measure ac or dc current using any sensitive voltmeter having banana jack inputs with a standard “ spacing. Two 5-way binding posts become the current input terminals. The precision, 0.018 shunt resistor will pass 10 amperes continuously without overheating, or up to 20 am peres for one minute. Not compatible with Y8132, Y8134 or TL70 test lead sets.

Sensitivity: 10 mV per ampere
Shunt Resistance: 0.01Ω
Accuracy: ±0.25%, from dc to 10 kHz, typically rising to 1 dB at 100 kHz
Series Inductance: 8.3 nH
Overload: <20A, not fused

Rack Adapters

See page 487 for rack mounting accessories

Y9108 BNC-Banana Adapter $15

BNC-to-banana adapters permit interconnection between equipment having BNC plugs and equipment with double banana jacks. Caution: Do not use BNC Connectors for floating measurements. See page 486.

M00-100-714 Panel Protector $10

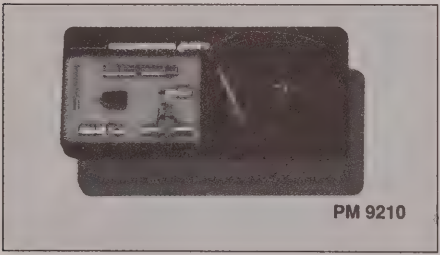
Dust cover for 8000A, 8600A, 1900A, 1910A, 1911A and 1912A. See page 486.

Philips-Produced Accessories

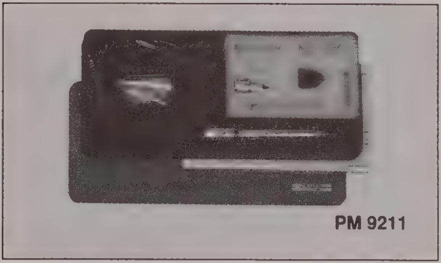
Specifications for PM 9210, PM 9211, PM 9212 and PM 9213

	PM 9211/00	PM 9211 w/Atten.	PM 9210	PM 9210 w/PM 9212	PM 9213
Frequency Range	10 kHz-1 GHz	10 kHz-1 GHz	100 kHz-1 GHz	100 kHz-1 GHz	10 kHz-100 MHz
Straight Line Within 5%	100 kHz-6 MHz	100 kHz-6 MHz	100 kHz-6 MHz	100 kHz-6 MHzx	30 kHz-30 MHz
Maximum Deviation	3 dB	3.5 dB	3 dB	3.5 dB	3 dB
Voltage Ranges (f.s.)	2 mV-2V	2V-200V	150 mV-15V*	15V-200V	10 mV-15V
Maximum Voltage AC	30V	200V	30V	200V	30V
Maximum Voltage DC	200V	500V	200V	500V	350V
Input Capacitance	2 pF	2 pF	2 pF	2 pF	40 pF
T-Piece	Included		Optional	Included	Not Available
Frequency Range	1.25 at 700 MHz	1.15 at 1 GHz		1.25 at 700 MHz 1.15 at 1 GHz (With Attenutor)	
Price	Not Available*	Not Available*	$259	$479	$69

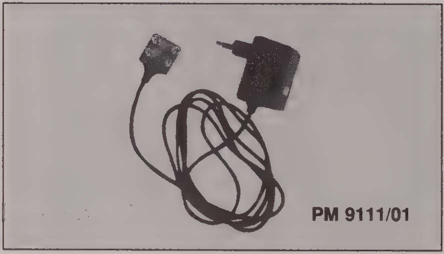
PM 9210 1 GHz, 50Ω Probe $259


PM 9210

PM 9211*

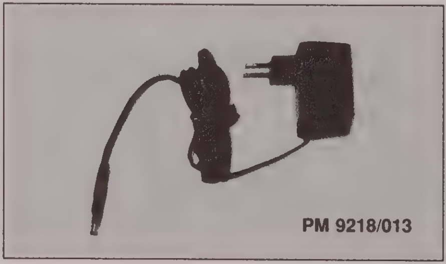

PM 9211

PM 9111/01 9V dc Power Supply*


PM 9111/01

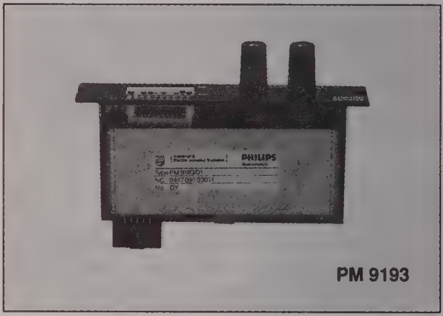
Input Voltage: 220V (±10%)
Line Frequency: 47...63 Hz
Power Consumption: 3 VA
Input Adapter: 2-Pole Universal European
Output Voltage (2x): 9V dc ±10%
Maximum Output Current: 10 mA

PM 9218A/013 Power Adapters $40


PM 9218/013

Provides power cord operation for PM 2518 and PM 2504.
Line Voltages: 110, 220 and 240V ±10%

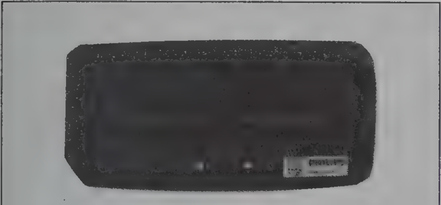
PM 9193/01 Analog Output Opt $350


PM 9193

Can be used with PM 2534 and PM 2535
Power Supply: 5V (±5%)
Connector: 4 mm female banana type
Output Voltage: 0...1V
Output Protection: Short-circuit protected
Output Resistance: 200Ω
Accuracy: ±0.25% of reading ±0.25% of range
Dimensions: 118 W x 25 H x 60 mm D (4.6 x 1 x 2.4 in)

Not Available in North America

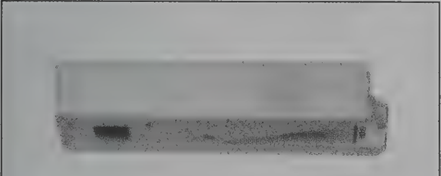
PM 9244 AC and DC Current Shunt Max 31.6A $69



PM 9244/00

Current Ranges: 10A and 31.6A
Frequency Range: DC...1 kHz
Output Voltage: 100 mV or 31.6 mV at full range
Accuracy: ±1% (100 mV range); ±2% (31.6 mV range)
Dimensions: 140 W x 55 H x 65 mm D (5.5 x 2.2 x 2.6 in)

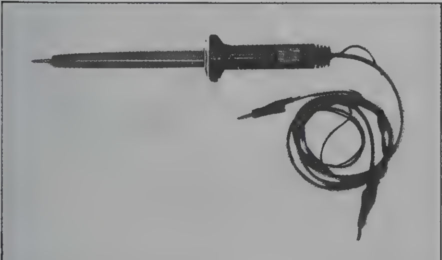
PM 9245 AC Current Transformer $65



PM 9245

Range: 10...150A
Transfer Factor: x1000
Accuracy: ±0.5% at 50 Hz; 2% for 40 Hz...10 kHz
Maximum Voltage to Ground: 400V (AC or DC)

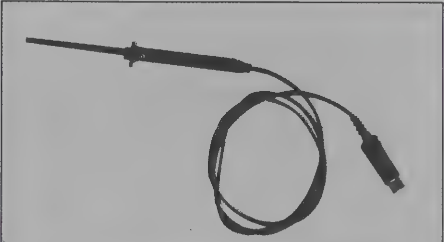
PM 9246/03 High Tension Probe $149



PM 9246

Maximum Input Voltage: 30 kV
Attenuation: x1000
Input Impedance: 600 MΩ ±1%
Accuracy: ±2%
Temperature Coefficient: ±200 ppm/°C
Voltage Coefficient: ±0.5 ppm/V
Input Impedance Meter: 10 MΩ, 100 MΩ or 1.2 MΩ
Output Connectors: 2 x 4 mm banana plug

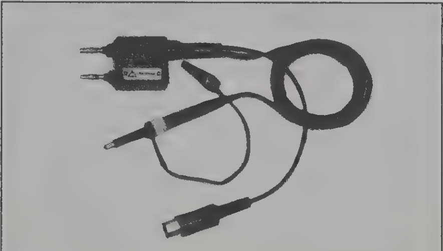
PM 9249/01 Temperature Probe $150



PM 9249/01

Application: Surface and liquids
Temperature Range: -60°C...200°C
Resolution: 0.1°C
Accuracy (excl. DMM): ±0.5%
Connector: 5-pole DIN (180°)

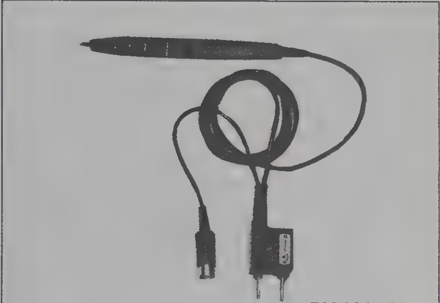
PM 9263/01 Data Hold Probe $85



PM 9263/01

Maximum Input Voltage: 30V rms
Input Resistance: 130Ω
Input Capacitance: 300 pF
Rated Range of Use: -10...+55°C
Storage and Transport: -25...+70°C
Humidity Operating Limits: 10...80%
Maximum Dew Point: +25°C

PM 9267/01 Data Hold Probe $150



PM 9267/02

Maximum Input Voltage: 30 kV
Attenuation: x1000
Input Impedance: 600 MΩ ±1%
Accuracy: ±2%
Temperature Coefficient: ±200 ppm/°C
Voltage Coefficient: ±0.5 ppm/V
Input Impedance Meter: 10 MΩ, 100 MΩ or 1.2 MΩ
Output Connectors: 2 x 4 mm banana plug

PM 9278/02 Ever-ready Case $75
PM 9279/01 Carrying Case $139

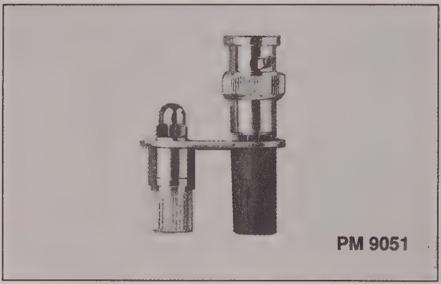
PM 9279/01

PM 9278/02

Sturdy shock resistant case with paddings on the inside, for shock absorption and space for accessories

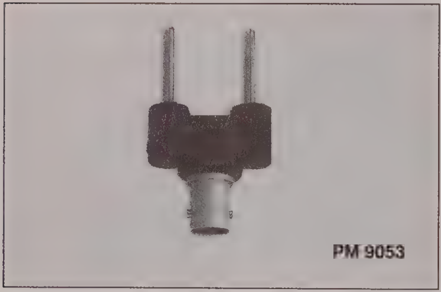
Philips-Produced Accessories

PM 9051 Adapter BNC (m) - banana (f) $9



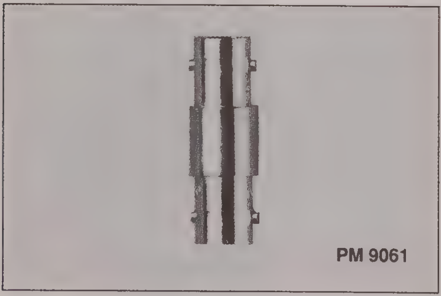
PM 9051

PM 9053 Adapter banana (m) - BNC (f) $14



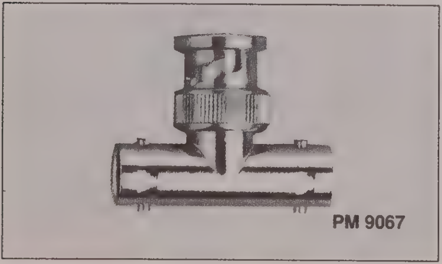
PM 9053

PM 9061 Adapter BNC (f) - BNC (f) $7



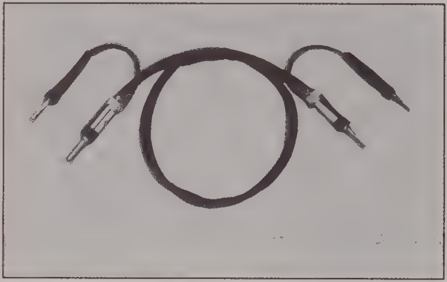
PM 9061

PM 9067 T-piece 1 x BNC (m) - 2 x BNC (f) $13

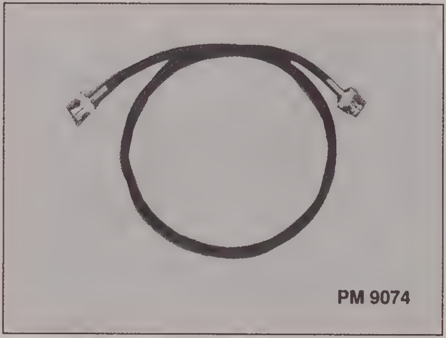


PM 9067

PM 9071 Measuring cable 135 Ω banana (m) - banana (m) $35

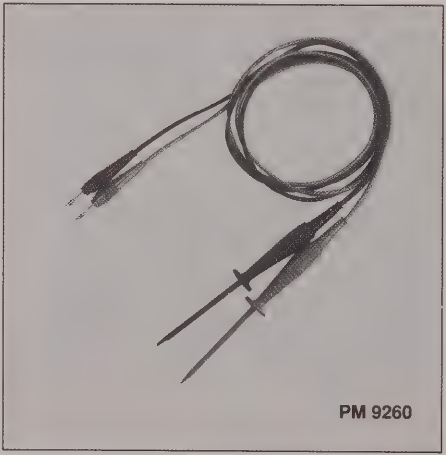


PM 9074 Measuring cable 50 Ω BNC (m) - BNC (m) $11



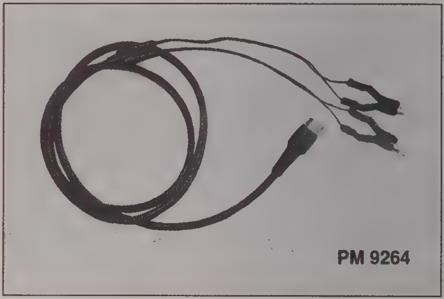
PM 9074

PM 9260/00 Set of test leads with probes $30



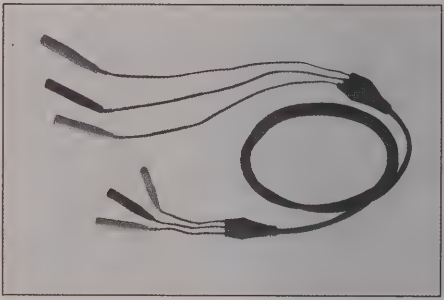
PM 9260

PM 9264/01 4-wire test leads/clips for resistance measurements $85

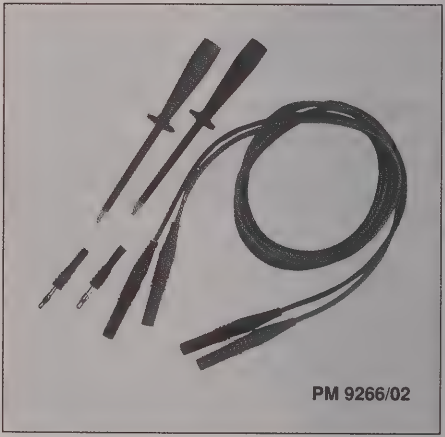


PM 9264

PM 9265/01 Shielded 3-wire test lead $110



PM 9266/02 Set of safety test leads with probes $39

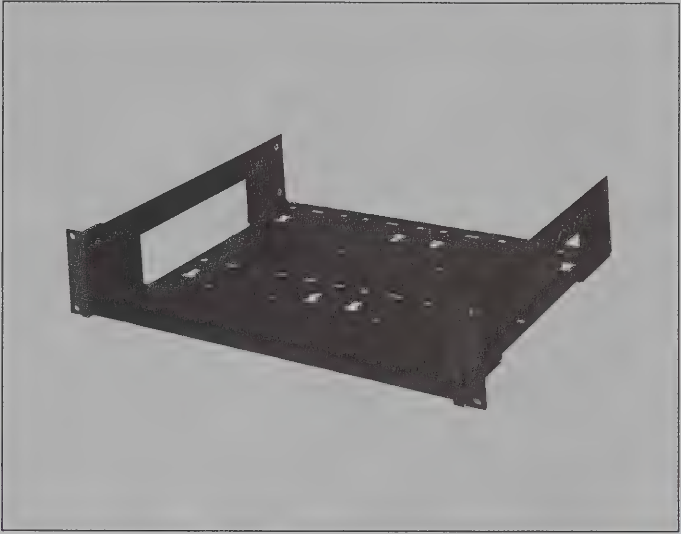


PM 9266/02

PM 2193/01 19-inch rackmount $275

Height: 3/E (133 mm 5.22")
Also fits PM 2525

PM 9280/02 19-inch rackmount $175



Height: 3E (133 mm 5.22")
Also fits PM 2534/PM 2535 and System 21

Rackmount Kit HM 9606/00 $95

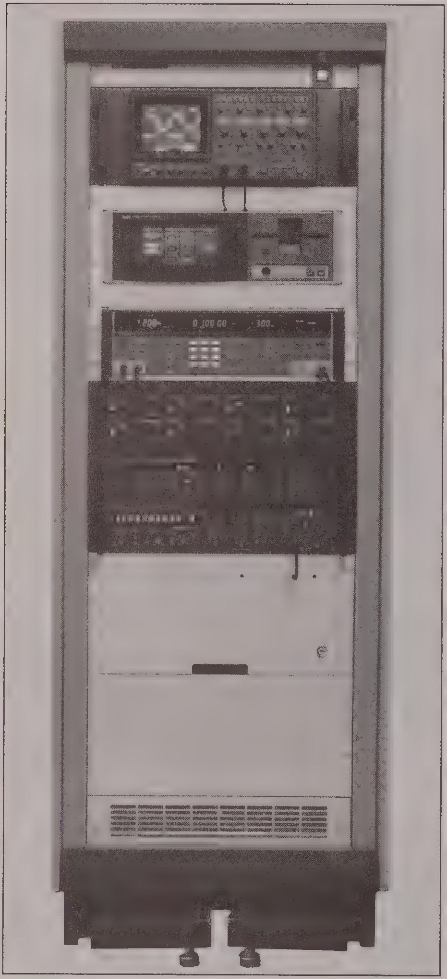
The HM 9606 rack kit is designed for use with the PM 2534/35 family of DMMs. The HM 9606/00 allows mounting of one PM 6665/6/9 Counter plus one PM 2534/35 DMM or one Fluke model 8840/42 DMM. The HM 9606/00 requires 5 1/4 inches of rack space. (See page 358 for photo).

**Not available in North America*

Philips-Produced Accessories

System 21 Modular GPIB/IEEE-488 Switching System

See page 380



System 21 is a modular range of switching, digital I/O, A/D and D/A units for GPIB-488 test systems. Their main application is in switching interconnections between the device under test and the instruments, controlled via the IEEE-488 bus.

GPIB/IEEE-488 Software

PM 2230 Series Instrument Drivers See page 376

PM 2240 TestTeam See page 374

TestTeam, together with instrument drivers, is a software package for the PC and PS/2 which greatly reduces development time for GPIB programs, and allows the user to take full advantage of the features of Fluke and Philips instruments.

Logic Analyzers

Page 153 PM 3655

Page 145 PM 3570

The Philips line of logic analyzer covers a broad range of applications including:

1. Low cost solutions for 8 Bit microprocessors.
2. Complete 32 bit support, including disassemblers for the Intel 80386, Motorola's 68020 and others.
3. Fast 100 Mhz x 96 channels state logic analysis to support RISC and bit slice designs.
4. 400 Mhz or 2.5 nanosecond transistional timing providing long time records and high resolution.
5. Multiple clocks to support mixed state and timing or multiple microprocessor designs.
6. Complete data qualification with both hardware qualifiers and range recognizers.
7. MS/DOS software to automate measurements and analysis for manufacturing applications or automated comparisons to design data.
8. Local Fluke support including fast service and services like:
   - a. Technical support
   - b. Seminars on digital testing
   - c. Classes on how and when to use a logic analyzer

The combination of outstanding basic specifications like minimum probe loading, short set up and hold times, low timing skew and abundant S/W packages for post processing make the Philips line a sure and complete solution. Add to that the local Fluke support and you'll find the best value per dollar in the industry for logic analysis.

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Introduction

Logic Analyzers: Cost-Effective Tools for Digital Development

Today, there is a fast-moving trend for digital technology to replace analog in products in virtually every field; from washing machines and other domestic appliances to professional products and systems of every possible kind. Against this background, the right development and testing tools are absolutely essential in the product design process. It is no longer sufficient just to identify faults; their origins must also be located.

The ideal answer to this requirement is provided by the Philips range of logic analyzers.

These instruments offer powerful state and timing analysis capabilities to locate hardware and software faults; and on some instruments a combination of the two — a valuable feature during the critical hardware/ software integration process. Philips logic analyzers offer complete capabilities for analysis of hardware and software performance; in many cases all the user's problems can be handled by a single instrument.

Careful attention has also been given to ergonomic aspects of these high-performance instruments, ensuring that they are simple to use and easy to understand.

Suitable for All Applications

Philips logic analyzers are suitable for applications at all levels, from research and development, production, to field service and education. Each model offers both state and timing modes to give the user a total logic analysis capability, at clock speeds of up to 400 MHz for the top-of-the-range PM 3570 model.

Every type of applications is covered by the Philips range. Top models are the PM 3565/ PM 3570, two extremely advanced analyzers for systems-based applications, with 115 channels and a clock speed of up to 400 MHz, fully ready for 32-bit applications. The PM 3655 is a low-cost, full specification 100 MHz analyzer with 96 channels. This instrument has none of the performance trade-offs between speed, width and memory usually associated with instruments of this price.

Overviews of instrument set-up are displayed using a menu structure, showing at-a-glance the status of each measuring mode and considerably simplifying operation.

A variety of display formats, including a wide range of disassemblers for specific microprocessor types, allows the user to achieve the optimal display format for a particular application.

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Data Acquisition

For data acquisition from the system under test, Philips offers a selection of compact, lightweight test probes which do not mechanically strain the connection points. These probes present a very high input impedance of 1 Mohm to the test circuit, together with a very low capacitive load, so that they do not interfere with its normal functioning. A variety of probe types are available for easy connection to the test circuit, including touch, DIL clip, pin-grid, LCC (leadless chip carrier) or low profile. Test leads are color-coded for easy identification.

Varying threshold levels enable the analyzers to handle different logic families, including ECL, TTL, MOS and CMOS. The number of input channels varies according to the instrument — the PM 3570 has 83 dedicated state channels and 32 timing channels; the PM 3655 has 96 channels all available for state and timing analysis.

Data sampling can be either synchronous for state analysis, or asynchronous for timing analysis.

Data Storage

The logic analyzer's memory is an important performance factor: the memory must be large enough to store all parallel output data, and fast enough to handle the sampling rate required for a particular application or test system. The transitional memory principle used on the high-performance PM 3565 and PM 3570 instruments greatly increases the efficiency of memory utilization, making timing windows effectively much wider than on conventional instruments. The PM 3655 has a full 2 kbytes memory available on each channel, irrespective of the tasks being performed by the instrument, including glitch capture.

For state analysis, Philips PM 3565 and PM 3570 logic analyzers offer 1k-words of state analysis memory. Extensive qualification facilities optimize use of memory by enabling data sampling on only those system actions that actually need to be monitored. Qualification can be performed on clocks, words, triggers or blocks of data.

Versatile System Connection

Philips logic analyzers are controllable via RS-232 and GPIB interfaces allowing convenient use in PC-controlled environments. In these cases, individual user programs can be used for applications like watchdog system monitoring, and storage and retrieval of measurement set-ups and data on floppy or hard disk.

The PM 3655 not only has Centronics, RS 232 and IEEE-488 interfaces for system operation as standard, but is designed with all the functionality of a PC. Operation of the logic analysis functions is a menu driven and as familiar as a PC; in addition it can operate as a full function, MS-DOS PC with disk storage.

PM 3570 and PM 3565: Logic Analyzers for Tomorrow's Systems

With the PM 3570 and PM 3565 logic analyzers, Philips gives system engineers a powerful set of tools that meet the challenge of today's leading-edge technology. With no less than 115 channels and an extremely fast 400 MHz acquisition speed, they are ready to handle 32-bit development projects. With 35, 59 or 83 state channels, PM 3570 is a powerful and versatile instrument that covers most requirements for software testing and debugging.

Transitional timing analysis ranges from 32 channels at 100 MHz, 8 channels at 400 MHz or mixed-speed combinations. Dedicated personality adapters and family-oriented disassemblers provide support for 8-, 16- and 32-bit microprocessors. PM 3565 offers an entry-level configuration with up to 59 state and 16 timing channels.

PM 3655: The Full Function Low-Cost Logic Analyzer

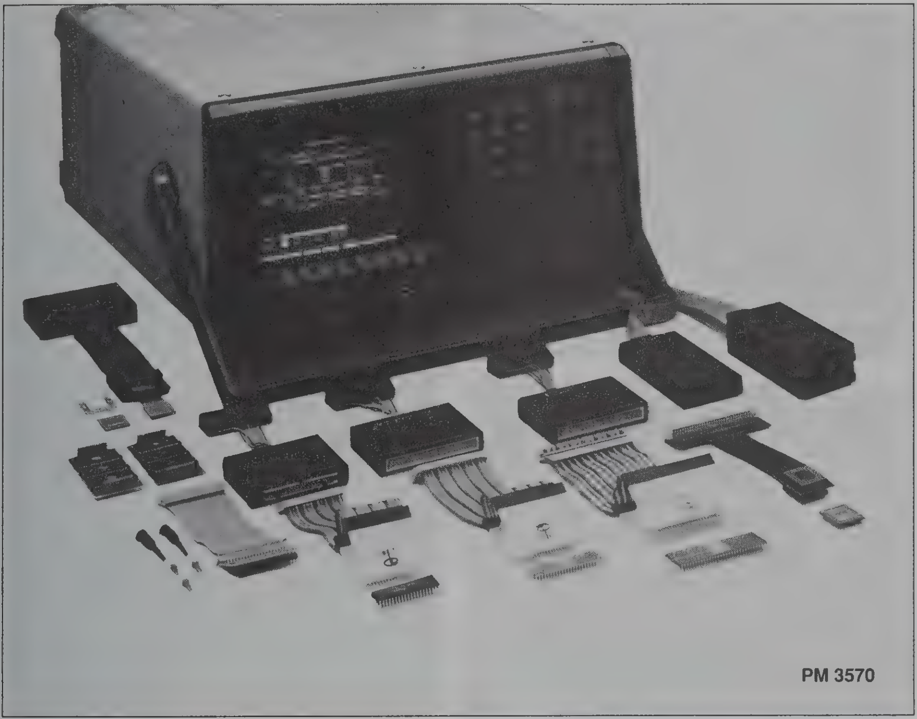
The PM 3655 offers a full 100 MHz sampling rate, synchronous or asynchronous, on all 96 channels, extremely fast for an instrument of this price. Moreover, using this full speed does not compromise performance of any other function. This is true of all the functions of this instrument — using glitch capture does not use any of the 2k bits of memory per channel or reduce speed; the PM 3655 operates at full speed and channel width, with glitch capture and retains 2k bits per channel.

Furthermore, it is expandable with a maximum of 4, 24-channel plug-in modules, allowing the user to specify exactly the power needed, while still having expandability assured. Also, operation is based entirely on the familiar PC, with normal keyboard, high resolution screen and menu-driven operation; and it also has a separate bus-architecture allowing it to function as an MS-DOS PC without affecting logic analysis capabilities.

PM 3565 & PM 3570

GPIB IEEE-488

RS-232



PM 3565 & PM 3570 Logic Analyzers

- Configurable logic analyzer up to 115 channels
- 400 MHz transitional timing for infinite acquisition memory depth
- Time correlation mode between state and timing with dual screen display
- Performance analysis
- Wide range of 8, 16 and 32 bit microprocessor disassemblers
- Multi-level fully conditional triggering with selective data acquisition
- GPIB/IEEE-488 and RS-232C remote control interfaces

Keeping ahead of today's fast-moving technological advances demands the right development environment. Including the necessary tools to monitor every stage of the process: from the development and testing of hardware and software subsystems, right through to total-system integration and performance testing.

With the PM 3565 and PM 3570 Logic Analyzers, Philips gives system engineers a powerful set of tools that streamline and speed the development process. Tools that meet the challenge of today's leading-edge technology. Ready for 32-bit development projects with no less than 115 possible channels and ultra-fast 400 MHz acquisition.

State Analysis

Modular system upgrading for up to 115 state channels.

Transitional Timing Analysis

With a capability extending from 32 channels at 100 MHz up to speeds of 400 MHz, alternately usable as up to 32 additional state channels (for an unmatched total of 115 state channels).

Combi and Time-Correlated Modes

The photo shows time-correlated state and timing analysis with dual-screen display plus 32 channels simultaneously in state and timing modes without the need for dual-probing.

Performance Analysis

To optimize the speed of your code and monitor execution in real time, the PM 3570 and PM 3565 offer extensive performance analysis features.

When more speed is needed, what sections of your code should you rewrite in assembly language? The PM 3570 and PM 3565 offers the tools to make the right choice the first time.

Transitional Timing

A Philips innovation that gets maximum mileage out of the logic analyzer's memory by capturing only those events that the operator wants to see. Transitional timing ensures that even the smallest pulses are captured, but without capturing the same information several times and wasting precious memory. For example, two 5 ns pulses, separated in time by more than 20 minutes, can easily be captured in a single acquisition shot!

Versatile Analyzer Configurations

As well as the ultra-high performance, 115-channel PM 3570 configuration, a simpler system configuration is also available as the PM 3565. This system covers up to 59 state channels and 16 transitional timing channels at 50 MHz, with four channels (also using transitional timing) switchable to 300 MHz. The PM 3565 configuration is ideal for 8-bit microprocessor system production testing and service applications.

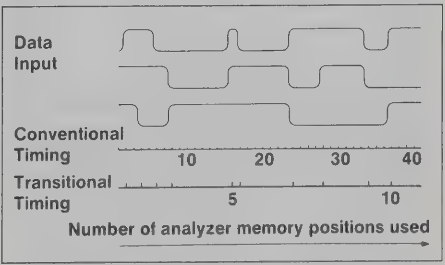
Broad Microprocessor Support

Philips has one of today's broadest ranges of dedicated subsystems for microprocessor support. Extending right up to the latest 32-bit devices, with support for newly introduced chips following fast.

Plus Fluke and Philips Worldwide Support

The PM 3570's tangible benefits in performance and technology are backed-up by renowned support. Based on our own know-how as a leading manufacturer and user of advanced microprocessor-oriented systems.

That know-how enables us to provide the user with the most advanced tools, as well as all the support needed to get maximum benefit out of the investment.



Both transitional and conventional timing analyzers give the same time resolution, but a transitional analyzer only uses memory in case there are changes on the data channels.

PM 3565 & PM 3570

Softkey Simplicity

One of PM 3570's most significant user features is its softkey simplicity. Eight softkeys, uniquely defined by adjacent on-screen labels, let the user enter instructions step-by-step.

These eight keys provide direct, easy access to over 300 different functions.

Future-Oriented Concept

PM 3570 and PM 3565 are part of a total future-oriented concept in logic analysis. Whatever application, it's virtually certain that these instruments will match it: whether it's state-oriented (8-bit, 16-bit and onwards), hardware-oriented (high-speed ECL), or both.

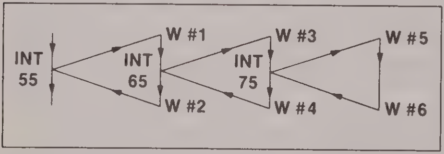
It is possible to expand up to 115 state channels, or 83 state channels plus 32 timing channels running at 100, 200 and 400 MHz.

State Analysis

PM 3570 provides a flexible, modular state analysis capability with up to 83 channels; starting with a standard 35-channel configuration and expandable in two further 24-channel steps. In addition, the high-speed 32-channel timing module can also be switched to state analysis, providing a total of no less than 115 state channels, usable for multi-channel testing applications.

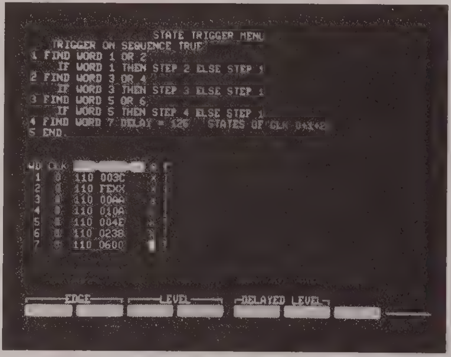
Trigger Menu

The operation of the trigger menu function is illustrated by this example of a three-deep priority interrupt on the 8085 processor. Here, WORD 1 identifies that the INT 5.5 service routine has been called, WORD 2 identifies the end of the routine. WORD 3 identifies the start of the INT 6.5 routine. If WORD 2 is encountered before WORD 3, the trigger if reset to step 1 to avoid a further INT 5.5 service routine. The same is true if WORD 4 is encountered before WORD 5, but the trigger is then set to step 2 to await the next INT 6.5 interrupt. PM 3570 is only triggered on WORD 6 when the full three-deep interrupt has occurred. That is, when INT 6.5. which is, in turn, interrupted by INT 7.5.

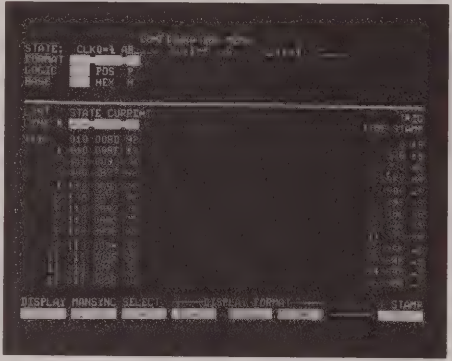


State List With Time-Stamping

In addition to versatile display facilities, it is also important to know which time intervals have elapsed between the consecutive states of the system under test. With PM 3570, it is possible to measure these elapsed times by time-stamping all the required states in the state list. Time-stamping can be absolute, i.e. starting from a defined starting point (trigger word) after which time runs cumulatively, or relative, in which the elapsed time of each state is shown individually.



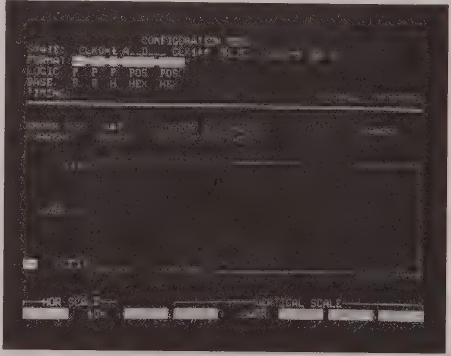
```
                 STATE TRIGGER MENU
   TRIGGER ON SEQUENCE TRUE
1 FIND WORD 1 OR 2
     IF WORD 1 THEN STEP 2 ELSE STEP 1
2 FIND WORD 3 OR 4
     IF WORD 3 THEN STEP 3 ELSE STEP 1
3 FIND WORD 5 OR 6
     IF WORD 5 THEN STEP 4 ELSE STEP 1
4 FIND WORD 7 DELAY = 126  STATES OF CLK 0+1+2
5 END

WD CLK
 1   0  110 003C
 2      110 FEXX
 3      110 00AA
 4      110 010A
 5      110 004E
 6      110 0238
 7      110 0600
```



State Graph Display

The graph display plots state analyzer memory contents against memory addresses — often useful for tracking overall software flow, or in monitoring ànalog-to-digital conversion. State graph display and state list are tightly coupled. As a result, moving the cursor in the graph display automatically co-scrolls the state list, and vice versa.

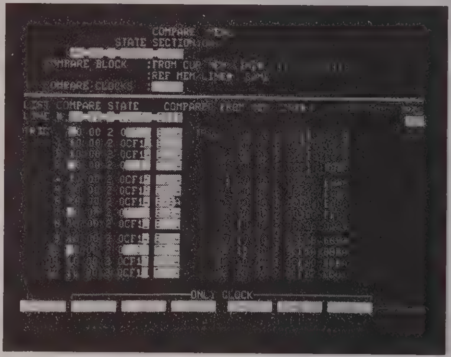
Recognition of repetitive loops or illegal memory accesses is much quicker than in a state list. So placing the cursor on a specific point of interest in the graph display, and then switching-over to the state list, directly reveals that area in terms of system state lines.



Compare Facilities

The PM 3570 provides sophisticated compare facilities for the fast location of system faults such as wrongly executed branches or incorrect data transfers. Data patterns of interest can be stored in reference memory, after which single- or multi-shot acquisitions of the new system data can be compared with the reference pattern.

Sections of the compared memory can be masked off and shifted, while further qualification is possible on a channel-by-channel or sampling-clock basis. Compared results are then displayed, with differences high-lighted in reverse video.

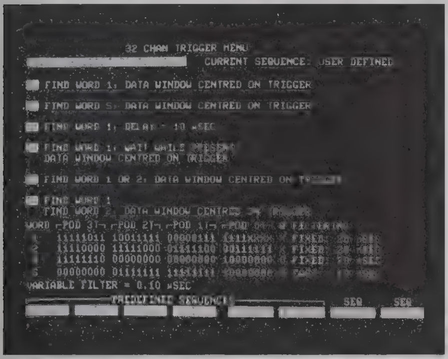


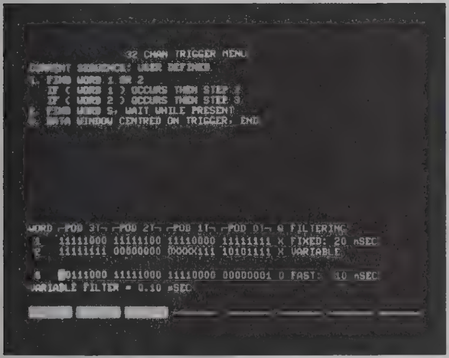
Transitional Timing Analysis

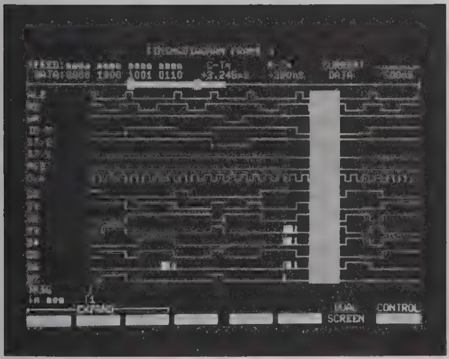
Philips' renowned transitional timing principle ensures optimal utiliaztion of available memory capacity by capturing only status changes; instead of conventional systems which capture data continuously, even when no events occur. PM 3570 has two separate memories; one for data and a second for time. If there is any change in one of the channels being examined between one sample and the next, the old data is loaded into the data memory, while at the same time the duration for which this data was valid is loaded into the time memory. PM 3570 therefore captures only the important transitions, even though it samples at constant intervals. Use of the transitional timing principle therefore enables PM 3570 to capture even the smallest pulses, without wasting valuable memory by repeatedly capturing unchanged data.

With a powerful, software-selectable choice of 32 transitional timing channels at 100 MHz, software-switchable to 16 channels at 200 MHz, 8 channels at 400 MHz, or combinations of these, PM 3570 has the capacity and versatility to handle every timing analysis requirement.

For example, a number of channels can be set to 100 MHz, while others are set to 200 or 400 MHz, giving a combination of these three sampling speeds at the same time. Working at 200 MHz allows detection of 7 ns pulses or glitches on 16 channels without any problem, while at sampling speeds of 400 MHz, pulses down to 5 ns or less can be captured on 8 channels. Powerful triggering is offered with four re-usable and independent trigger words of 32 bits each. Triggering is possible at any of the 3 available trigger levels at speeds of up to 400 MHz.


32 CHAN TRIGGER MENU
CURRENT SEQUENCE: USER DEFINED
FIND WORD 1, DATA WINDOW CENTRED ON TRIGGER
FIND WORD S, DATA WINDOW CENTRED ON TRIGGER
DATA WINDOW CENTRED ON TRIGGER
FIND WORD 1 OR 2, DATA WINDOW CENTRED ON
FIND WORD 1
FIND WORD 2, DATA WINDOW CENTRED
VARIABLE FILTER = 0.10 µSEC
SEQ
SEQ


32 CHAN TRIGGER MENU
USER DEFINED
IF (WORD 1) OCCURS THEN STEP
IF (WORD 2) OCCURS THEN STEP 3
WAIT WHILE PRESENT
WINDOW CENTRED ON TRIGGER, END
11111000 11111100 11110000 11111111 X FIXED: 20 nSEC
11111111 00000000 XXXXX111 10101111 X VARIABLE
0111000 11111000 11110000 00000001 0 FAST: 10 nSEC



Timing Display Facilities

PM 3570's display facilities offer 4 available frames of any 16 timing channels to be displayed at the touch of a button for maximum user convenience. Of course, every timing channel can be preceded by a user-definable timing label, while a number of preset timing labels are also available. Timing reference measurements are easily carried out. All that is necessary is just to place the reference marker on desired edge, and move it to the next edge of interest. The measured time can then simply be read out to 5 decimal places! An important system attribute here is that a settable reference veil, indicating a specific time interval, can be moved right along the timing display. This allows quick searching of pulses of a specific length.

Cursor scrolling can be continuous or in discrete steps, such as edge-to-edge or page-by-page. The cursor can also be positioned immediately at a trigger word, as well as at the beginning or end of memory.

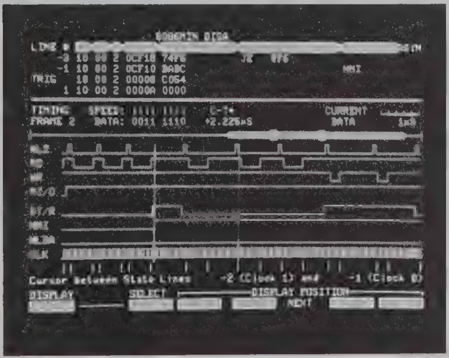
Time-Correlated Mode for Simultaneous State and Timing Analysis

As well as completely independent state and timing analysis sections, PM 3570 also allows both state and timing analysis sections to run together. This facility is particularly valuable in the hardware/software integration stage of a development project, when it is essential to check the interactions of system hardware and software, as well as for debugging and optimizing total-system performance.

In PM 3570's Combi mode, the state section can trigger the timing section, or vice versa; a powerful tool in determining true total-system behavior. It is also possible for one analyzer section to wait in its trigger sequence for the other analyzer section to proceed.

Analysis is extended even further in the selectable Time-Correlated mode in which the timing analyzer is running in synchronism with the state section. In this situation, state and timing displays are fully cross-referenced, so both state and timing conditions can be examined simultaneously at any specific moment in system operation.

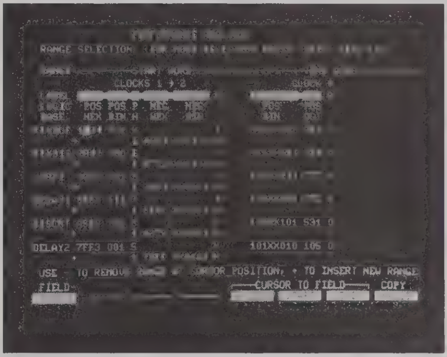
The availability of a dual-screen mode allows both state information (disassembled if required) and timing waveforms to be shown simultaneously but with full cross-coupling. This allows superfast detection of errors by searching for irregularities in one part of the display, for example timing, and studying their effect on program flow in the other part of the display.



Performance Analysis

The PM 3570's performance analysis mode is essential in the final development phase after functional system testing has been completed.

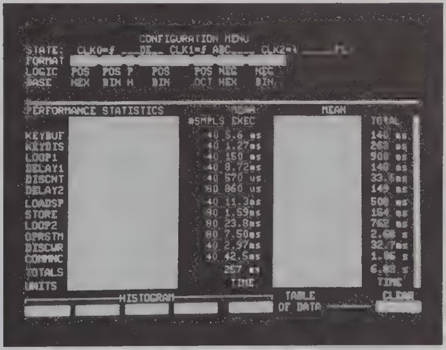
Performance analysis monitors 12 sections of your code and presents an analysis, complete with graphics, as to which section code takes the longest time or is called most frequently. This tool quickly isolates where code should be optimized for faster operation



Essential in Hardware/Software Integration

The task of the hardware development is to create hardware modules that match the electronics specification in terms of signal timing, levels, fan-in and fan-out etc. An important tool for the hardware team is a logic timing analyzer that offers at least 16 channels, and with sampling speeds of up to 400 MHz for high-resolution analysis.

Concurrently, the software development team will be writing all the code modules and linking them together.

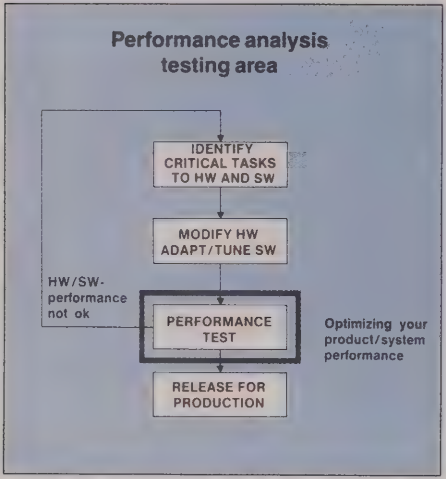


These separate activities are followed by the more difficult task of integrating hardware and software subsystems, either or both of which may then need further modification and testing. At this stage, an essential verification tool is the combined logic state and timing analyzer, offering sophisticated (synchronized) state and timing analysis, combined with full disassembly facilities.

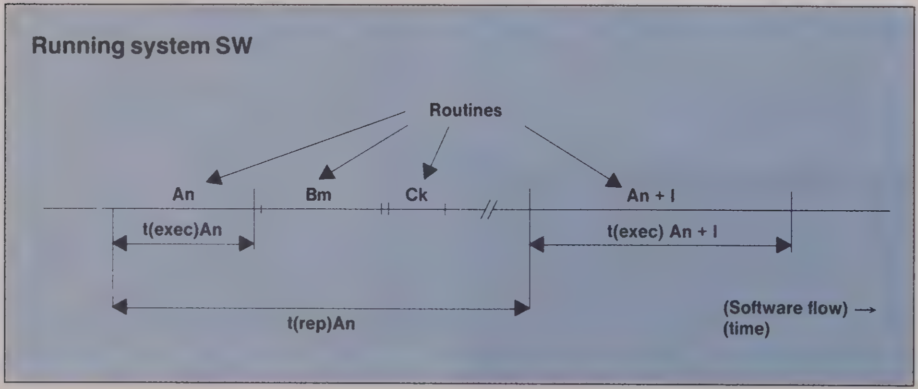
PM 3565 & PM 3570

Real finished-product software can be implemented after completion of the first working prototype with test software. Of course, it is essential to remove major system bugs, but this alone is not enough to ensure efficient and optimized system operation in accordance with the defined system tasks.

For example, it may be found that overall system run-times aims are not met, possibly due to the occurrence of long wait states caused by bottlenecks in the execution of system routines.


Performance analysis testing area
IDENTIFY CRITICAL TASKS TO HW AND SW
MODIFY HW ADAPT/TUNE SW
HW/SW-performance not ok
PERFORMANCE TEST
Optimizing your product/system performance
RELEASE FOR PRODUCTION

The diagram below shows a part of the program running in the system. Three routines are shown - A, B and C - together with an indication of execution time and repetition time for one of the routines. These execution and repetition times need not, of course, be constant. They can vary according to the level of system activity.



This allows a 'mean' execution time to be computed, giving a first indication of routine behavior. The mean is calculated by taking the average values of a selectable number of measured samples, for example 100, of either the execution or repetition time. Detailed measurements of execution/repetition periods of all 12 ranges can also be made, revealing important statistical information like minimum and maximum period values and standard deviations.

PM 3570's powerful combination of performance analysis facilities includes the following four operating modes:

- Event frequency, for measurement of the relative frequency of occurrence of a maximum of 12 address ranges
- Range period overview mode, for measurement of mean execution and repetition periods for a maximum of 12 ranges
- Range period overview mode, for measurement of individual execution and repetition periods for each range
- Complement period, for measurement of the time during which the system is active outside a maximum of four address ranges

Other special performance analysis features are 'ignore' and 'recursive routine' modes. Ignore mode allows an ignore word to be specified, which causes acquisitions passed through this word not to be merged with existing data. Measurements subject to interrupts can then be ignored, and the number of ignored events is also counted. The recursive routine mode enables repeatedly called routines to be recognized. This is not normally possible with other logic analyzers, which usually assume that a routine is ended after recognition of the END word. Up to 255 deep recursive routines can be recognized in this way, together with an indication of maximum and minimum values.

GPIB/IEEE-488* Bidirectional Control Interface

All logic analyzer functions are controllable at three distinct levels:

- Keyboard commands: all key operations can be simulated from a remote host
- Menu-level commands; complete sets of menu parameters can be set at once
- Instrument-level commands; all instrument parameters can be set at once

Of course, up- and downloading of instrument (reference) data are also possible via the IEEE-488 interface.

All bus communications are handled in accordance with IEEE-488/IEC-625 protocol, while service requests are handled by a complete, built-in control activated by the logic analyzer's operating system.

RS-232-C Bidirectional Control Interface

As with the IEEE-488/IEC-625 interface, all analyzer functions are controllable at the same three distinct levels of operation. Here again, up- and downloading of measurement (reference) data are also possible. All link communications according to the RS-232 standard are built in, together with a complete service request control system.

RS-232-C Printer Interface

Both the IEEE-488/IEC-625 and RS-232-C cards contain an additional, independent, RS-232-C printer interface which is provided for print dump output.

Printout can be handled in a number of ways:

- Printout listing of listed data per page
- Printout complete data listing
- Printout of all instrument menus
- Printout (hard copy) of any analyzer screen on a dot-addressed graphics printer (dedicated to Epson LX80/FX80/85 graphic printer types)

IBM PC-AT Interconnection

Remote control and post-processing of data are vital attributes in today's research and development environment. These tasks can be handled highly effectively by connecting the PM 3570 or the PM 3565 to a PC or work station, thereby providing access to powerful and versatile data processing and storage capabilities.

A software communications package is available for this purpose supports connection to the IBM PC and PC-AT, and compatibles. The package runs under the computer's PC- DOS (or MS-DOS) operating system, and provides complete remote control of PM 3570 from the PC-AT plus file-oriented storage of settings and measurement data on floppy or hard disk.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Specifications

Technical Specifications

State Modules

Input: Via PM 8821 or PM 8825 multi-lead active pods
PM 8821: 4.7 MΩ//6 pF
Max. Input Voltage: -50V...+50V
Max. Sensitivity: 250 mV threshold overdrive
Threshold: Selectable TTL, ECL or variable per pod
TTL: +1.4V
ECL: -1.3V
VAR: -3v...+12V in 100 mV steps

Clocks and Qualifiers

Three External Clocks
Min. Repetition Time: 50 ns
Min. Clock Pulse Width: 15 ns
Up To Four Clock Qualifiers
Set-Up Time: 12 ns, with respect to active clock edge
Hold Time: 0 ns, with respect to active clock edge

Memory

Depth: 1023 words
Width: 35 bits or 59 bits or 83 bits. Reference memory of similar size

Triggering

Trigger Words: 7 words of 83 bits max.
No. of Trigger Levels: 7
Trigger Modes: Sequential, conditional, on-sequence-break
Trigger Source: From state, from timing, external

Selective Data Acquisition

Sections Between Trigger Words
Sections of Words A, B With/Without Delay
A, B Word Width: 83 bits max.

32-Channel Timing Module

Input: Via PM 8826 dual timing pods, 1 MΩ//5 pF
Max. Input Voltage: -50V...+50V
Max. Sensitivity: 200 mV threshold overdrive
Threshold: Selectable TTL, ECl, or variable
TTL: +1.4V
ECL: -1.3V
VAR: -3...+12V in 100 mV steps

Clock and Qualifiers

Clock Source: Internal, external or from state

Channel Speed Configurations With Internal Clock

32 Channels at 100 MHz: (Sample interval 10 ns)
16 Channels at 200 MHz: (Sample interval 5 ns)
8 Channels at 400 MHz: (Sample interval 2.5 ns) Plus 22 mixed 100/200/400 MHz channel/speed configurations
Storage Mechanism Transitional
Memory Depth: 256 to 512 x 10^6 samples, 1024 to 131 x 10^9 samples (optional)
Max. Recording Time: 5 min.; 22min. (optional)
Reference **Memory:** Same values
Glitch Capturing: 4.7 ns
Max. Undetected Pulse: 4.7 ns
Channel-to-Channel Skew: 2 ns
Triggering: 4 independent words of 32 bits + 1 external trigger bit
Trigger Levels: 3, either sequential or conditional
Trigger Source: From timing, from state, external
Glitch Triggering: Via timing triggering
Triggering Time Delay: From 0 ns to 335 ms
Final Trigger Delay: PRE, CENTER, POST

Channel Speed Configurations With External Clock

32 Channels at 100 MHz Max: Asynchronously
Max Memory Depth: As with internal clock (transitional)
31 Channels at 50 MHz Max: Synchronously
Clock Qualifiers: 4
Memory Depth: 512 samples, 2048 samples optional

8-Channel/50 MHz Timing Module

Input: All inputs via PM 8825 multi-lead active pod
Input Impedance: 1 MΩ//5 pF
Max. Input Voltage: -50V...+50V
Max. Sensitivity: 200 mV threshold overdrive
Threshold: TTL, ECL or variable
TTL: + 1.4V
ECL: - 1.3V
VAR: - 3V to + 12V in 100 mV steps
Clock: Internal, fixed 20 ns sampling rate 8 channels, 50 MHz
Storage mechanism transitional
Memory Depth: 256 to 256 x 10^6 samples
Reference Memory: Same values
Max. Undetected Pulse: 24 ns
Channel-to-Channel (pod) Skew: 2 ns
Min Detectable Glitch Width: 5 ns on 8 channels
Triggering: On all data channels + 1 external trigger bit, from state
Trigger Modes: On word, on glitch in word, on glitch in window
Trigger Time Delay: From 0 ns to 20 ms
Final Trigger Delay: From 0 to 255 transitions

4-Channel/300 MHz + 8-Channel/50 MHz Timing Module

Input: As for 8-channel/50 MHz timing module
Clock: Selectable between 300 MHz (3.3 ns) or 50 MHz (20 ns)
Memory Depth: 256 to 256 x 10^6 samples (50 MHz); 1536 to 128 x 10^6 samples (300 MHz)
Reference Memory: Same values
Max. Undetected Pulse: 5.5 ns
Channel-to-Channel (pod) Skew: 2ns
Min. Detectable Glitch Width: 5.5 ns
Triggering: From timing, from state
Trigger Time Delay: From 0 ns to 20 ms
Final Trigger Delay: PRE, CENTER, POST

RS-232-C Printer Dump Interface

Prints alphanumeric data to any RS232-compatible printer. Prints graphic data to Epson FX80, or compatible printer
Format: 1 start bit, 7 data bits, 1 parity (E), 1 stop bit
Speed: 110, 150, 300, 600, 1200, 2400, 4800, 9600 bits/s

RS-232-C Control Interface

Format and speed for RS-232 printer interface
Modes: Load and dump with PM 4202 cassette drive full control with any RS232 control unit, (host PC)
Control Levels: Key level, menu level, instrument level
Data transferred can be instrument settings and/or reference data
Separator: CR, NL, CRLF (default), EXT, ETB

IEEE-488/IEC 625 Interface

Implements SH1, AH1, T6, L4, SR1, RL1, DC1, DT1
Control Levels: Key level, menu level, instrument level
Data transferred can be instrument settings and/or reference data
Separator: CRLF and EOI default, CR, LF, ETX, ETB
Transfer Speed: 1 KB/s

General Specifications

Video Output: Composite video output standard; 50 Hz refresh, BNC connector; 1V peak-to-peak into 75Ω
Power Supply: 110, 127, 220 or 240V AC ±10%; 50/60 Hz ±10% (400 Hz on request). Conforms to IEC 348 safety class I and ECMA 57 requirements. Power Consumption 550 VA (max.)

Ambient Temperatures

Rated Range of Use: +5°C...+40°C
Operating: -10°C...+55°C
Storage and Transport: -40°C...+70°C

Altitude

Operating: <5,000m (16,400 ft.)
Not Operating: <15,000m (49,200 ft.)

Humidity

Operating: 20%...80% RH (non-condensing)
Not Operating: 5%...95%\
Electromagnetic Interference: Conforms to VDE 0871, Level N - 12 dB
Recovery Time: Operates within 30 minutes after - 10°C soak, going into 60% RH at + 20°C room conditions
Size: 237 mm H incl. feet, 450 mm W plus handle, 600 mm D incl. backstanders plus handle (9.3 in H incl feet, 17.7 in W plus handle, 23.6 in D incl backstanders plus handle
Weight: 18 kg (39.4 lb) approx.Operation

PM 3565 & PM 3570

Operation

Menus

Upon menu selection, all parameters are entered by softkey and hex pad. User prompting and error messages appear on the screen. The menus are:

Configuration: The organization of clocks, clock qualifiers, channels, thresholds and state labels, as well as sampling speed (timing) and polarity

Triggering: The definition of the point at which data acquisition is to stop

Selective Data Acquisition: The definition of which data from the data stream is to be captured

Compare: The definition of which data is to be compared in the main and reference memories

Option: The selection of a required disassembler and parameter setting of the RS-232 printer interface, RS232 control interface and the IEEE control interface

Performance Analysis

Built-in as standard. Divides code (system SW) into max. 12 ranges, identifiable by start and end of word in Range Selection Menu

Modes of Operation

- Event frequency for occurrence of ranges; min. repetition time: 50 ns
- Range period for (averaged) execution and repetition times with minimum and maximum values plus standard deviation
- Complement period for range period of system activity outside max. four selectable ranges

Special Features

Ignore: Exclusion of exceptional/spurious events

Continue: Recognition of recursive routines

Data Displays

List: Listing of state/timing captured data

Time: Displays a waveform diagram (timing diagram) representing the contents of the timing analyzer memories

Graph: XY-oriented display plotting memory contents against address values

Table: Tabular representation of event frequency, mean execution, repetition and total time period data (performance analysis)

Histogram: XY-oriented bar graph representing event frequency, execution (mean) period, repetition (mean) period, total time and complement period data. Histogram of recursion depth (performance analysis)

Data Display with Compare

List: Irregularities between current and reference memories are highlighted

Time: Irregularities between current and reference memories are underlined

Non-Volatile Memory Facilities

Stores up to four user settings; last setting always saved after power-down. Stores all available state/timing reference data, including performance analysis results. Built-in as standard.

Universal Disassembler Option

Universal disassembler package with four user-definable disassemblers in case no particular disassembler from the above table applies. Useful for disassembly of military CPUs, bus systems, etc. User can specify e.g.:

- Disassembler name (9 characters per dissassembler name)
- PM 3565/70 configuration incl. clocks, qualifiers
- Translation table and mnemonics (max. 256 per disassembler)

Delivered as normal disaboard with one empty socket. All user-defined data to be stored in one 2764 which fits in socket. Two 2764s are supplied: one empty, another with example disassemblers (e.g. IEEE-488 bus). Max. 4 disassemblers packs (EPROM boards) can be installed per instrument.

Personality Adapters (Also see page 158)

To allow easy target clip-on connection to PM 3565/70, compatible with PM 8821, PM 8825 and PM 8826 pods. Two hard-wired types are available:

PM 8817/40: 5 pods to 40-pin DIL clip

PM 8817/64: 8 pods to 64-pin DIL clip

Prewired personality adapters are available for many microprocessor types. See list above. All pluggable parts of PM 8817/XX can be ordered separately.

PM 8816/XX: Personality housing for

PM 8817/XX: same range as PM 8817/XX

PM 8815/40: 40-pin DIL-clip with flat cable and connector (to PM 8816/XX)

PM 8815/45: 40-pin DIL low-profile (12 mm height) with flat cable and connector (to PM 8816/XX)

PM 8815/48: 48-pin DIL-clip with flat cable and connector (to PM 8816/XX)

PM 8815/64: 64-pin DIL-clip with flat cable and connector (to PM 8816/XX)

PM 8815/65: 64-pin DIL-clip low profile with flat cable and connector (to PM 8816/XX)

PM 8815/68: 68-pin grid array front-end with flat cable and connector (to PM 8816/XX)

PM 8815/70: 68-pin grid array front-end with flat cable and connector (to PM 8816/XX) (Intel Version)

PM 8815/71: Pin grid to Lcc converter

PM 8815/72: 114-pin grid array front-end with flat cable and connector (to PM 8816/37)

PM 8815/00: five pod noses allowing connection of PM 8821 /25 /26 pod to PM 8816/XX (personality housing)

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Ordering Information

Models

January 1989 prices

Item	Price
PM 3565 Logic Analyzer	$3750
PM 3570 Logic Analyzer	4000

Options

Item	Price
PM 8853/60 Logic State Module 35 channel/20 MHz	3000
PM 8853/50 Logic State Module 24 channel/20 MHz	2000
PM 8853/70* Logic State Module 24 channel/20 MHz	2000
PM 8853/30* High Speed Timing Module, 32 channels, 100/200/400 MHz, 1/2 kB mem.	6000
PM 8853/90* High Speed Timing Module, 32 channels, 100/200/400 MHz, 2 kB mem.	9000
PM 8852/70** Logic Timing Module, 8 channels, 50 MHz	2500
PM 8853/80** Logic Timing Module, 8 channels/ 50 MHz, 4 channels/ 300 MHz	3500
PM 8856/20* RS232 Control	750
PM 8856/30** RS232 Control	750
PM 8856/40* IEEE Control	750
PM 8856/50** IEEE Control	750
PM 8821 8-Channel State Probe	350
PM 8825/10 8-Channel Fast Timing/ State Pod	500
PM 8826* 2 x 8-Channel Dual Timing Pod	1000
PM 8827* 32 Channel Single Probing Adapter	500

Accessories (Also see page 158)

Item	Price
PF 8701 General Purpose Software Communications Package	200
PM 8811 Serial Data Pod	1195
PM 8819 Extension Kit	75
PM 8819/10 54 Colored Leads	75
PM 8819/20 35 Measuring Clips (black)	75
PM 8819/30 50 Mini Clips (red)	75
PM 8819/40 54 Colored Leads	75
PM 8819/50 54 Colored Leads	75
PM 8893 Protective Front Cover	40
PM 8991/04 Cart	450
DL 3633 Pouch	50

**for PM 3570 analyzer only*
***for PM 3565 analyzer only*

Service & Support

Warranty

One-year warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see page 491.

Microprocessor Support

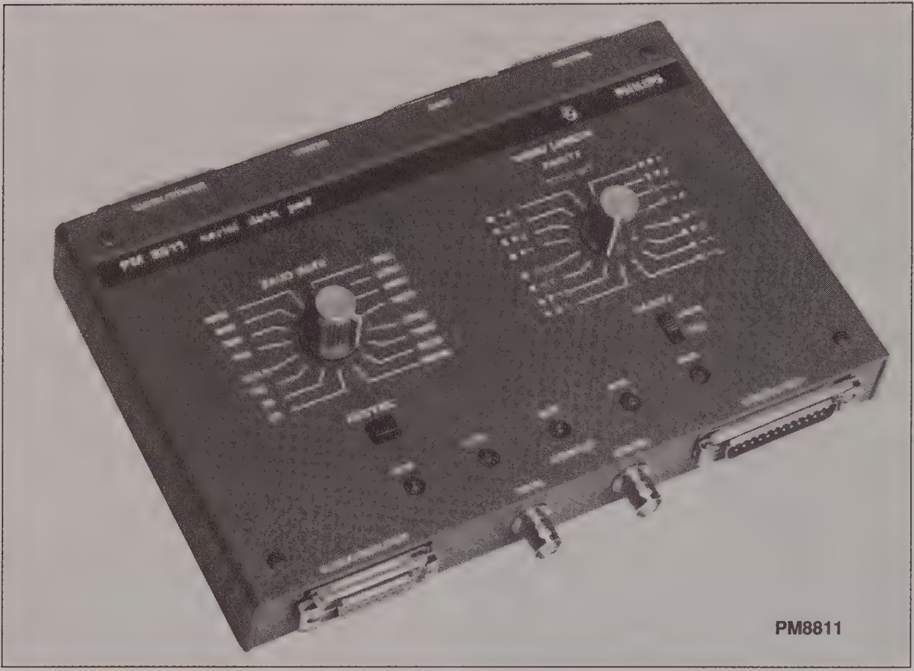
Type		Disassembler package	Personality adapter	Front-end
Motorola	6800	PM 8858/00 (M1 pack)	PM 8817/10 PM 8816/10	40-pin DIL 40-pin LCC
	6802/6808	PM 8858/00 (M1 pack)	PM 8817/10 PM 8816/10	40-pin DIL 0-pin LCC
	6809	PM 8858/00 (M2 pack)	PM 8817/26	40-pin DIL
	6809E	PM 8858/00 (M1 pack)	PM 8817/26	40-pin LCC
	68000, 68010	PM 8858/10 (M2 pack)	PM 8817/19 PM 8816/19 PM 8817/36	64-pin DIL 64-pin LCC 64-pin grid array
	68008	PM 8858/20 (M3 pack)	PM 8817/32 PM 8816/32	48-pin DIL 40-pin LCC
	68020	PM 8858/30 (M4 pack)	PM 8817/37 PM 8816/37	114-pin grid array 114-pin LCC
	68HC11	PM 8858/90 (M5 pack)	PM 8817/68	52-pin PLCC
Intel	8080	PM 8858/40 (N1 pack)	PM 8817/28 PM 8816/28	40-pin DIL 40-pin LCC
	8085	PM 8858/40 (N1 pack)	PM 8817/20 PM 8816/20	40-pin DIL 40-pin LCC
	8031/51	PM 8858/40 (N1 pack)	PM 8817/30	40-pin DIL
	8035	PM 8859/40 (X pack)	PM 8816/30	40-pin LCC
	8048	PM 8859/40 (X pack)	PM 8817/40	40-pin DIL
	8086/8088 min./max.	PM 8858/50 (N2 pack)	PM 8817/27 PM 8816/27	40-pin DIL 40-pin LCC
	80186	PM 8858/60 (N3 pack)	PM 8817/31 PM 8817/34 PM 8816/31 PM 8816/34 PM 8817/38	68-pin LCC 68-pin grid array 68-pin LCC 68-pin grid array 68-pin LCC and 68-pin grid array
	80286	PM 8858/70 (N4 pack)	PM 8817/35 PM 8816/35 PM 8817/39	68-pin grid array 68-pin LCC 68-pin LCC
	80386	PM 8858/80 (N5 pack)	PM 8817/41	132-pin grid array
Zilog	Z80	PM 8859/20 (Z pack)	PM 8817/22 PM 8816/22	40-pin DIL 40-pin LCC
Rockwell	6502, 6512	PM 8859/30 (R pack)	PM 8817/24 PM 8816/24	40-pin DIL 40-pin LCC
NS	NSC 800	PM 8859/30 (R pack)	PM 8817/12 PM 8816/12	40-pin DIL 40-pin LCCm
Universal adapter			PM 8816/40 PM 8817/64 PM 8816/64	40-pin LCC 64-pin DIL 64-pin LCC
Custom		PM 8859/10 (B pack)	User selectable	User selectable
disassembler (1)		PM 8859/00 (C pack)	User selectable	User selectable

1) Universal disassembler package with four user-definable disassemblers in case no particular disassembler from the above table applies. Useful for disassembly of military CPUs, bus systems, etc.
User can specify e.g.:
- *disassembler name (9 characters per disassembler name)*
- *PM 3565/3570 configuration incl. clocks, qualifiers*
- *translation table and mnemonics (max. 256 per disassembler)*

Delivered as normal disaboard with one empty socket. All user-defined data to be stored in one 2764 which fits in socket. Two 2764s are supplied: one empty, another with example disassemblers (e.g. IEEE-488 bus). Max. 4 disassembler packs (EPROM boards) can be installed per instrument.

PM 8811

RS-232


PM8811

PM 8811 Serial Data Pod

- Enables logic state analyzers to monitor RS-232/V24 data lines
- Both TX and RX data captured
- Adjustable speed and character formats
- LED indication of control line status

The PM 8811 serial data pod enables a parallel data sampling logic state analyzer to monitor the serial asychronously transmitted data present on RS-232C/V24 communication lines. By means of its front panel switches, the PM 8811 is easily adjusted to cope with all common transmission formats found on RS-232C lines. These enable word lengths of 5, 6, 7 or 8 bits with odd, even or no parity bits. 1, 1.5, or 2 stop bits may be selected and the 16-crystal controlled speed settings ensure accurate data capture.

Connection to the RS-232C/V24 line is simply made using the supplied special 'T' connector. The high input impedance of this pod avoids any possibility of excess line loading which could result in erroneous measurement.

PM 8811 monitors both the TX (PIN 2) and RX (PIN 3) lines simultaneously. This capability permits the action and immediate reaction of a system to be followed and, for example, enables rapid identification of 'echo' faults.

Framing error and parity error faults are also identified by the PM 8811. In addition the two BNC outputs enable a counter to be connected so that simple error rate measurements can be made.

Should multiple consecutive errors be identified by the PM 8811 it is possible that, via some other fault condition, synchronization with the RS-232C/V24 line being monitored has been lost. To overcome this the PM 8811 will automatically re-synchronize itself. It is also possible to manually re-synchronize the PM 8811 by pressing the RESYNC button. The status of the RTS, CTS, DSR, DTR and DCD control lines are indicated by means of five LEDs. This information is also available at one of the output connectors should it need to be monitored in conjunction with the captured serial data.

Serial data triggering and data display is dependent on the logic analyzer with which the PM 8811 is used.

Specifications

Specifications refer to both TX and RX inputs of the PM 8811

Speed: Selectable at 50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600 and 19,200 bits/s
Character Length: Selectable 5, 6, 7 or 8 bits
Parity: Selectable odd, even or none
Stop Bits: 1 or 2 bits for 6-, 7- and 8-bit characters; 1 or 1.5 bit for 5-bit characters
Input Impedance: 21 MΩ/<50 pF
Threshold: 0V
Sensitivity: ±3V threshold overdrive
Total BNC Output: Gives TTL output pulse on each character
Error BNC Output: Gives TTL output pulse on error characters
Power Requirements: +12V <10 mA; +5V <200 mA; -12V <10 mA (supplied from logic analyzer)
Size: 215 mm W x 45 mm H x 160 mm L (8.5 in W x 1.8 in H x 6.3 in L)
Weight: 0.75 kg (1.6 lb)
Included: T connector for connection to RS-232/V24 interface; Instruction Manual

Ordering Information

Models

January 1989 prices

PM 8811 Serial Data Pod for PM 3565/PM 3570 .... $1195

Service & Support

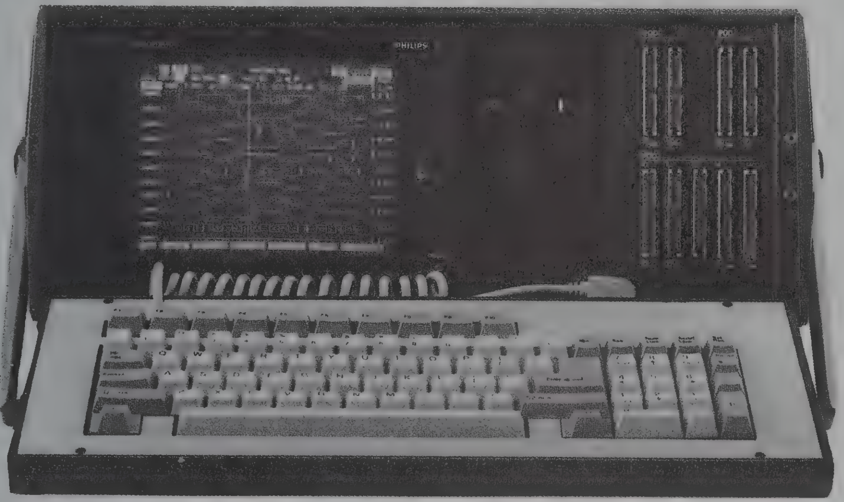
Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

PM 3655

GPIB IEEE-488

NEW



PM 3655

PM 3655 100 MHz 96 Channel Low-cost Logic Analyzer

- Full 100 MHz sampling speed on all 96 channels for timing and state analysis
- 2k bits of memory always available on all 96 channels
- 5 ns glitch capture on all channels, at full 100 MHz and with full 2 kbits memory
- Sophisticated multi-level triggering and 4 clock qualifiers
- High quality, high impedance probes
- Supports 8-, 16-, 32-bit micros and RISC architectures
- Modular design: field installable 24-channel modules
- Easy, familiar operation
- MS-DOS PC functionality

The PM 3655 is a low cost logic analyzer offering very powerful performance, always fully available regardless of the combination of functions in use, or the application. The user need make no compromise in performance demands - sampling speed is 100 MHz on all channels with no width or depth trade-offs; the full 2k bits memory per channel is always available; and the glitch capture does not reduce the speed or use any memory.

The PM 3655 offers the kind of performance not usually available in low-cost logic analyzers. This has been achieved with high performance ECL technology. Although it required greater effort in optimizing the design to obtain this high performance, ECL imposes none of the compromises at high speed associated with MOS.

Full Performance

The PM 3655 offers an extremely fast sampling rate for an instrument in this price class: 100 MHz on all 96 channels (synchronous and asynchronous), at full channel width performance that handles the latest micro technology, as well as preparing you for the next generation.

For capture of complex data flows or extended timing analysis, each channel has 2k bits memory, available with full channel width at full speed, even when glitch capture is in operation.

The 5 ns Glitch mode allows capture of very brief transients - again at full speed on all channels, with no loss of width or depth.

Triggering is comprehensive, so the user can find exactly the data required, and includes a powerful multilevel trigger word sequencer, true range recognition and 4 clock qualifiers. An Area Trace facility also serves to effectively extend memory.

These high performance levels also include the probes, which are high spec high impedance, so they do not distort signals or mask glitches.

Modularity

The PM 3655 has a maximum of 4 plug-in modules, each of 24 channels, giving the user a maximum of 96, with each channel capable of state and timing analysis at the full 100 MHz. Thus the user need not buy more power than needed, but is still assured of future expansion. A wide range of micro-specific disassemblers and personality adapters is available, for reduced effort in set-up, and this range is constantly being expanded.

Simple, Familiar Operation

Operation of the PM 3655 is based on the familiar PC. It is menu driven; entry is via a normal keyboard with display of up to 24 channels simultaneously on a high-resolution screen; and the user can define channel labels or trigger words. It also has on-line disk storage, with full HELP and tutorial facilities supplied on disk.

Plus PC Functionality

Also, to make it a real added-value instrument, the PM 3655 can function as a full MS-DOS based PC, with a completely separate bus-architecture that does not limit any of the logic analysis capabilities. In addition to the 5 $^1/_4$" disk drive, 4 expansion slots are provided for LAN cards, internal modems, memory expansion and so on. Instrument set-ups can be stored on disk for later use, and measurement data can also be stored for later analysis, on a different machine if necessary. PM 3655 will run additional MS-DOS software such as word processing packages, increasing the versatility even further. It has Centronics, GPIB/IEEE-488* and RS 232 interfaces as standard.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3655

100 MHz State Analysis on 96 Channels

In state analysis, logic analyzers synchronize data acquisition using clock signals from the target. If the acquisition speed of the analyzer is too slow for the target clock, real time state analysis is impossible, so the speed of the analyzer is critical in determining its range of application.

The PM 3655 logic analyzer can perform state analysis at 100 MHz on up to 96 channels. This provides a safe operating margin not only for the analysis of designs with today's modern microprocessors, which are already operating at speeds of up to 30 MHz, but not for tomorrow's higher speed processors. Indeed, the combination of clock speed and number of channels make the PM 3655 suitable for the analysis of 8-, 16-, and 32-bit applications, including the up and coming RISC architecture CPUs, ECL gate arrays and fast bit slice designs. And this doesn't mean for just some designs - set up and hold times of 2.5 ns ensure samples are correctly taken and all trigger word recognizers run at 100 MHz, for all applications.

96 Channels in Groups of 24

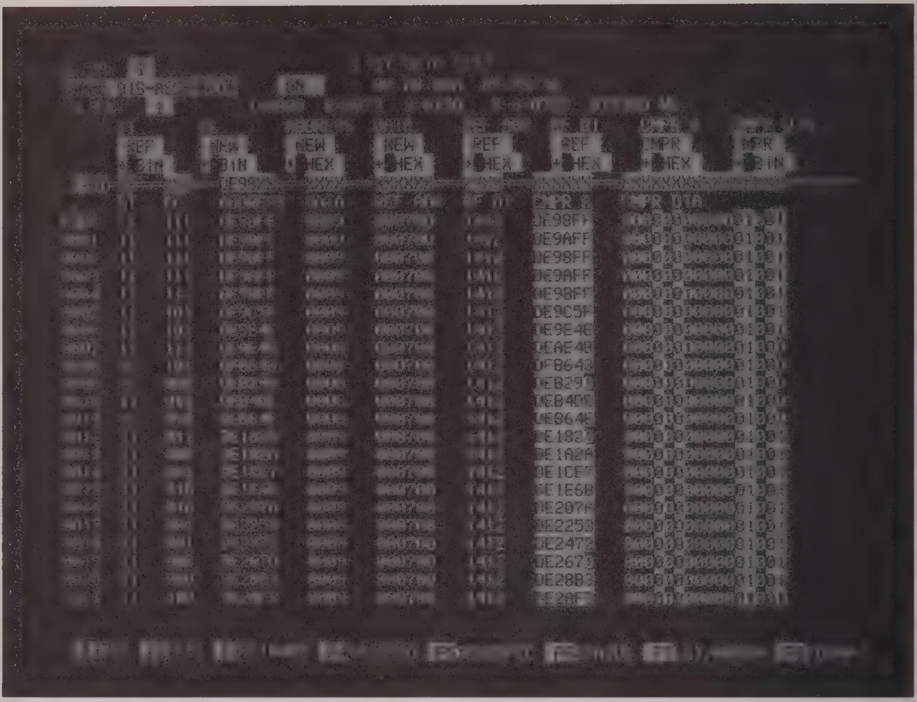
The modular design of the PM 3655 allows you to start with the minimum number of channels to satisfy your needs for simple timing and state applications, and add in extra cards to provide a maximum of 96 channels as your applications become more sophisticated. Each field installable 24 channel card, can be operated as an independent or interdependent logic analyzer for extra versatility. Each card can use a unique clock, clock qualifier and trigger; or the same clock qualifiers even when they are using different clocks. For added flexibility, different pre- and post-triggering parameters can be set for each card.

Powerful Triggering

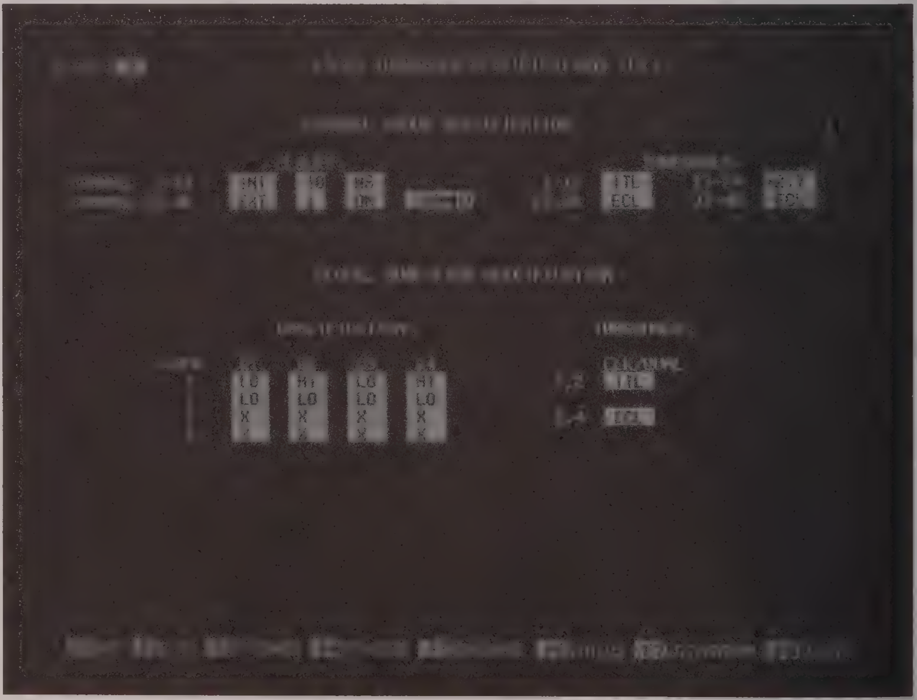
The PM 3655 can check for 4 trigger conditions and can simultaneously check for occurrence of 3 different trigger words from a choice of 12. Branching can be to the next or to a previous level; destination can be set individually per trigger word. Trigger words can be set to monitor up to 96 channels, i.e. over the full width of the analyzer.

Data acquisition can be stopped on any or all of the 24 channel modules, on any of 4 trigger levels. This allows both the cause of an error and the consequences to be captured by triggering different groups of channels, at different trigger levels.

A unique TIME-OUT triggering function can be defined on each trigger level, which locks in on events occurring within a user-specified time interval. If the events programmed on that trigger level do not occur within the pre-defined time limit, the TIME-OUT will activate and cause the trigger sequencer to proceed to another trigger level.



1. This state display highlights the differences between new acquisitions and reference memory, and also illustrates the wide number of channels that can be seen at once. The FIND feature allows a search for a specific word in memory.



2. Clock and threshold specifications allows clocks to be assigned to the 24 channel cards and thresholds to be set for ECL, TTL or variable. Four qualifiers can be allocated to each clock. Modules function as independent — or interdependent — logic analyzers in either state or timing modes.

2 kbit Memory Depth per Channel

Each channel in the PM 3655 can record an ample 2 kbits of states or events, providing long traces of, for example, a microprocessor's instruction flow.

The trigger position can be set at any position in the data memory and can be programmed to a one-sample resolution. Trigger position can be set to a different value for each of the 24 channel blocks, allowing from 2 kbits of pre-trigger data to 2 kbits of post-trigger data to be captured.

Using the trigger delay function (up to 65334 clocks/events), events occurring long after the trigger can also be captured.

Area Trace

By programming the PM 3655 to record only specific information, memory capacity can be optimized. Upper and lower range recognizers can be enabled or disabled on each of the 4 trigger levels. When the range recognizers are enabled, the analyzer will only record values that fall within the selected ranges and all others will be discarded. Not only does this make more efficient use of available memory, it also allows you to concentrate on only relevant data.

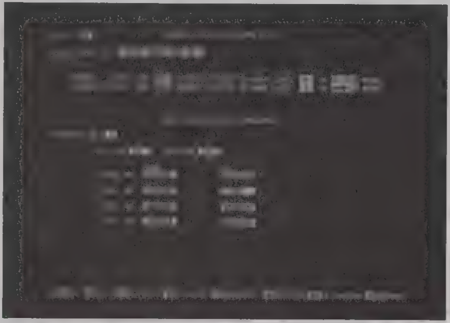
100 MHz Timing Analysis on 96 Channels

Each of the 24 channel groups can be used to perform timing analysis. All 96 channels can run at 100 MHz and the 2 kbit memory on each channel combines high resolution with a minimum of 20 µs recording length at the fastest clock speeds. All channels can be run off the same clock to provide a full 96 channel timing analysis.

Powerful Triggering

Up to 12 trigger words and four trigger levels can be used for timing analysis. Time filters can be used to "qualify" the trigger condition; only triggering when the data is valid for more or less than a specified number of clocks. Events can also be counted creating a powerful timing trigger potential. State and timing trigger sequences can be integrated: for example, results from a state analysis can be used to qualify a timing trigger sequence; or you can trigger on combinations of trace results and timing data.

All these features combine to provide endless timing possibilities ranging from isolating trouble caused by too fast or too slow chip response times to debugging real time applications.



4. *Record specifications screen shows the auto trace with no trigger enable. It's a free-running display that is continuously refreshed with new data. Each module's trigger point can be set to any amount of pre- or post-trigger data. And the trace qualification can be set, for each trigger level, to monitor an address range, I/O port, etc.*

Glitch Capture

The 5 ns glitch capture feature can be activated on all 96 channels without compromising either the maximum resolution (100 MHz) or reducing the memory available (2 kbits/channel).

In addition, high impedance (1MΩ/5/7 pF) probes ensure that short glitches are not suppressed by too much capacitive load and that in general, signals are not distorted.

Monitoring

The analyzer can set to capture a single event, when the acquisition is frozen on error detection, or continuously monitor signal activity. In this case, the AUTO-TRACE mode continuously updates the display on a set trigger condition or at regular 1 second intervals, allowing the user to monitor changes in the system without manually restarting the logic analyzer. This feature is invaluable for monitoring real-time applciations or debugging communications.

Comparison

The PM 3655 can also be set to capture data which is equal to, or not equal to, a set of reference data. A maximum allowed skew between the data may also be specified. The compare cycles are short, so the PM 3655 does not spend much time away from its main function of monitoring the system. Captured data can also be stored on disk, allowing you to monitor a system for intermittent faults and analyze the data at a later stage.

Combined State/Timing Analysis

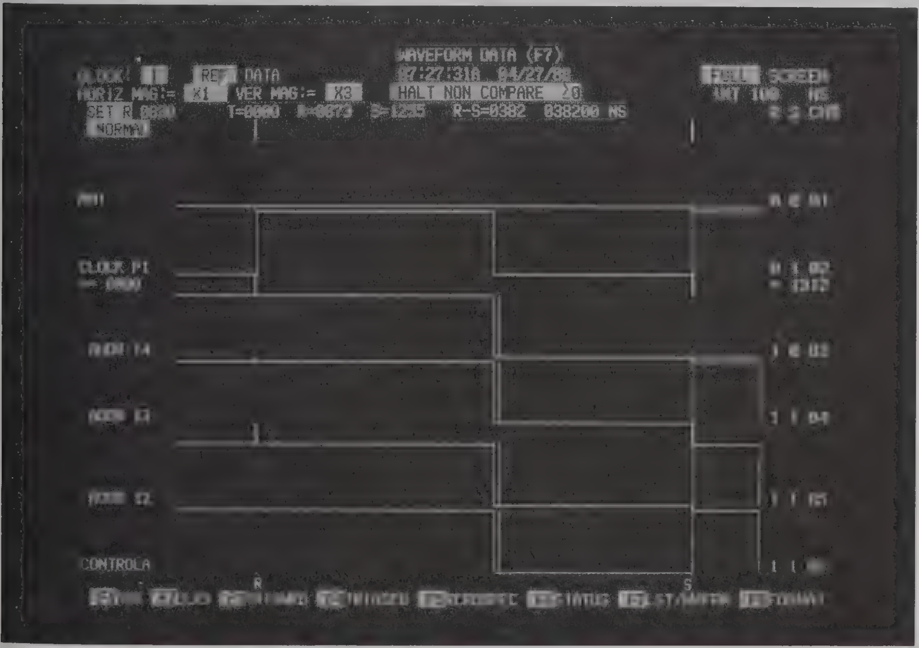
Each of the 24 channel groups can be assigned its own clock; either the internal clock for timing analysis or one of four external clocks for state analysis. This allows groups of channels to monitor a microprocessor while others are performing timing analyzes on, for example, interrupt lines. As indicated earlier, state and timing trigger sequences are completely integrated allowing a mix of states and timing events to be checked.

Data Display Options

PM 3655 has sophisticated on-screen display features showing detailed information for fast problem identification, analysis, and solution.

A full timing diagram containing up to 24 channels can be displayed on the large 9 inch CRT. Signals can be displayed in any convenient sequence (as opposed to the usual pin number order) - for example all data lines together, clock signals next to data lines and so on, and a signal may be displayed in more that one position. In this way, you can directly see how the triggering relates to a signal or group of signals.

Furthermore, a comparison display allows you to observe the difference between a set of reference data and a set of captured data. Functions that allow the user to compensate for timing skew between the signals are built-in.



3. *This timing diagram shows horizontal and vertical expansion, great for documentation.*

PM 3655

Waveforms

The displayed signals can be randomly selected from all 96 channels and displayed in any desired order. You can create up to four screens, allowing all 96 channels to be displayed. Each signal is identified by its pin number and an individual signal name to help you to analyze your results, and cursors can be used for timing measurements.

The horizontal zoom feature allows expansion of the time axis to measure more accurately timing differences between signals. A few critical signals can be selected for concentrated study by expanding the vertical axis with the vertical zoom. Both axes can be scrolled.

Data List

Data can also be shown as state lists. The state list layout can be set up as desired, using as many columns as necessary, mixing new data with reference data, showing bus data in hexadecimal and/or ASCII, and even showing individual lines in binary. This free format layout allows you to maximize the amount of useful information displayed and thus speed up problem analysis.

Disassembly List

Microprocessor specific disassemblers translate the data into machine code to ease program tracing and interpretation. The personality disassembler modules also arrange the data bus, address bus and status lines into a logical order on the display.

Split Screen

A split screen option allows you to display both state and timing signals simultaneously to observe both hardware signals and software flow. You can also combine waveforms and state lists, or disassembly lists, into one screen to check timing and state analysis at the same time. Both windows can be simultaneously scrolled, or scrolled independently so, for example, you can study program flow separately from the timing analysis.

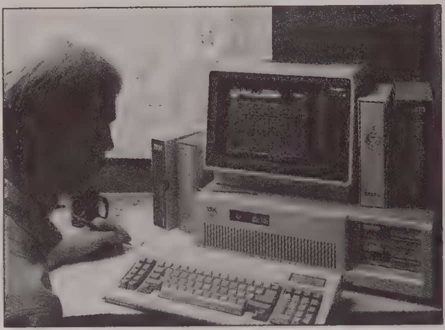
Familiar Operation Plus a PC

ASCII Keyboard

A familiar ASCII keyboard makes it easy to enter signal labels. Function keys give you direct access to any of the screens making most information available with a single keystroke. "Fill-in-the-form" style menus and pre-set selections make entry of labels and trigger words easy and it is simple to toggle between all the options. When finished, you have a complete picture of the set-up with no hidden sub-menus to obscure details.

Mass Storage

A 5¹/₄" double-sided double density floppy disk drive allows you to store captured data and frequently used setting, or to load reference data. Disks are MS-DOS compatible allowing files to be post- or even pre-processed. Series of measurements can be executed automatically by invoking special command functions similar to macros.

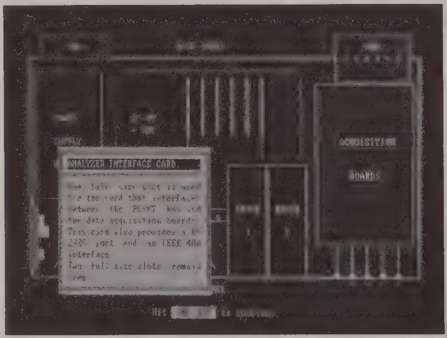


5. PM 3655 data running on a PC.

Additional PC Functionality

The PM 3655 can also be used as a personal computer. The 8 MHz 8088 main processor is PC/XT (turbo)-compatible with a separate bus architecture which ensures the logic analysis functions are not affected in any way. This allows the PM 3655 to run a range of MS-DOS software packages, so you can write reports on a word processing package, or integrate acquired data into spreadsheet packages. Your data can also be analyzed on a PC, as long as it has Hercules graphics.

Readily available software can also be used to convert the unit into an intelligent workstation, while four expansion slots allow you to upgrade or customize the logic analyzer with PC-plug in cards. These include internal modems, memory cards and LAN cards. A clock/calendar, Centronics printer port, RS-232C and IEEE-488 interfaces are standard on the PM 3655.



6.The tutorial offers a "manual on disk" for quick overview of the PM 3655 operation. You can run it on the logic analyzer itself or on a PC.

Specifications

Technical Specifications

Signal inputs

Data: 24 channel per block with a maximum of 4 blocks (96 channels)
Clocks: Internal; 20 Hz (50 ms)...100 MHz (10 ns) selectable in a 1-2-5 sequence. External; up to 4, each from DC to 100 MHz selectable positive or negative edge. Clocking; any clock can run any or all Data Blocks
Qualifiers: Up to 4; can be ANDed with any external clock. Each selectable for high or low state
Input Impedance: 1 MΩ/5-7 pF typical (8 pF max) at wire ends; all Data, Clock and Qualifier inputs
Min. Detectable Pulse: 12 ns in "SAMPLE MODE"; 5 ns in "GLITCH MODE".
Thresholds: Data-selectable in groups of 12 channels each. Clocks/Qualifiers-selectable in groups of 2 clocks and 2 qualifiers each. Range-selectable fixed TTL (+1.4 V), ECL (-1.3). Variable ±6.3 V in 100 mV increments.
Input Voltage: ±50 V continuous, ±100 V spikes with a max. duration of 50 µs.
Set-up Time: Data; must be present 2.5 ns (2 ns typically) before clock edge. Qualifers; must be present 5 ns (3 ns typically) before clock edge.
Hold Time: Data; must be held 2.5 ns (2 ns typically) after clock edge. Qualifiers; must be held 5 ns (3 ns typically) after clock edge.
Skew: Channel to channel 3 ns max.

Trigger

Type: "Edge"; this means that you must transition into the word selected for the instrument to recognize it. There is one exception; on level one of the trigger sequence, all "x's" (don't care) in the trigger word, will cause unit to automatically take a sweep of data and go into display
Width: Each trigger event may be specified as a 1 to 96 bit wide word (depending upon model) and terminate recording of all or each block of 24 channels
Specification: Trigger words can be specified in Hex or Binary format
Position: Trigger location may be specified anywhere in memory from 0 to 2038 and defaults to memory location 0047
Delay: Record window also may be delayed by clocks or events from 0 to 65534
Conditions: 4 levels with up to three words and a 255 clock time out per level, with multiple branch between levels. Full "IF-THEN-ELSE" control on each level. Area trace on each block, up to 96 channels wide. Any level can terminate any or all bolcks selected. When transferring from one level to the next the analyzer may not recognize trigger words for 40 ns worst case (30 ns typically).
Digital Filter: Trigger on words "greater" than 0-15 clocks long; trigger on words "less" than 2-15 clocks long

Recording

Glitch Mode: Every channel is capable of "glitch" catching down to 5 ns, selectable in blocks of 24 channels each

Memory Size:

1 card;	24 x 2048 bits deep
2 cards;	48 x 2048 bits deep
3 cards;	72 x 2048 bits deep
4 cards;	96 x 2048 bits deep

Conditions: Single trace-records data from start until trigger is found; completes recording, stops and automatically goes into display. Auto trace-continuously captures and displays data with or without a trigger word.

Compare/Non-Compare-R and S cursors used to select comparison zone. Comparison skew can be specified from 0-9 clocks for synchronous/asynchronous recording. Unit continues to run until condition is found; stops and goes into display.

In Timing, non-equal data between cursors shown as a one. In State non-equal data is displayed in reverse video.

Storage-back-up memory stores all recorded data and is selectable by block.

Set-ups - 2 set-ups are provided without accessing disc memory.

Display

Timing: Max. 24 channels per display

Horizontal Expansion; x1, x2, x5, x10

Vertical Expansion - 3, 6, 12, 24 channels

Any channel may be moved to any other location for display functions.

Cursors-Trigger-R and S. Difference between R and S shown in samples (external clock) or time (internal clock).

State: Data display selectable in ASCII, HEX, BINARY, OCTAL and DECIMAL by individual channel or block. Also, can be grouped in any combination up to 192 channels with eight separate groups available.

Disassemblers: 8-,16- and 32-bit CPUs shown in their respective mnemonics (disassemblers are optional). Devices currently supported are listed towards the end of this chapter.

Probe

Data: Maximum 8 data pods, each having 2 probes with 6 channels and two grounds leads each

Clock/Qualifier: Separate clock/qualifier pod with one probe for each function, each having 4 inputs

Disassembler (optional): Personality probes and cables are provided for matching 8-, 16- and 32-bit microprocessors

Circuit Interconnect: Pods are supplied with individual channel leads with 0,025 square sockets attached. Miniature clips are supplied for each lead. Cable lengths from probes to Logic Analyzer are 4' ±0.5' for clock/qualifier pod and 6' ±0.5' for data pods.

PC-XT Turbo Operating System

Keyboard: Full ASCII IBM PC "XT" keyboard with 10 soft keys

Computer: IBM PC-XT-Compatible capable of running MS-DOS. (8088, running at 8 MHz, can be set to run at 4.77 MHz)

Memory Size: 256 kbytes expandable to 640 kbytes (optional)

Disk Storage: Storage and down loading from system to floppy disk of setups, data and disassemblers

Disk: One 5¼" DS DD floppy drive (360 K) as standard. Space is provided for a second drive

Display: Amber CRT with self prompting menus. Reverse Video indicates programmable fields

Expansion: Ability to add up to two ½ size IBM "XT" Boards and two full size IBM "XT" Boards for additional features

Systems Interface

RS 232: Included as standard. Baud rates 9600, 4800, 2400, 1200, 600, 300, 150 and 100. Programmable separator. Control level: key simulation. Instrument settings and/or measurement data can be up/down loaded.

IEEE-488: Included as standard. Implements SH1, AH1, T6, L4, SR1, LR1, DC1and DT1.

Control level: Key simulation, full instrument programmability. Instrument settings and/or measurement data can be up/down loaded. Programmable separator (CRLF is default). Serial and parallel polling. Talker/listener.

Parallel Printer Output (Centronics): Included as standard

External Start: 50 ms pulse, TTL active low via rear panel 9 pin "D" connector

External Trigger In: TTL active low via rear panel 9 pin "D" connector. Pulse width 20 ns min. This signal may be part of the trigger sequence and is selectable in the first word location on each level.

Trigger Out: TTL active low after block 1 trigger recognition via rear panel 9 pin "D" connector. Output signal varies depending on clock frequency, and location of block 1 trigger in trigger sequence. If last location, trigger out is steady state until re-start.

General Specifications

Power: 90...132 V_{AC}, 50...60± 2 Hz; fuse 5 A Slo Blo 200...264 V_{AC}, 50...60 ± 2 Hz; fuse 2.5 A Slo Blo Maximum continuous power available 420 W (300 W typically)

Power Interruption: 10 ms (nominal power supply) No influence on setting and data storage.

Temperature:

Rated range of use: +5...+35°C (+41...95°F)

Operating range: 0...+40°C (32...104°F)

Storage and transport: -40...+70°C (-40...158°F)

Humidity:

Rated range of use: 20...80% non-condensing

Storage and transport: 5...95%

Altitude:

Rated range of use: 5000 m (16000 ft)

Storage and transport: 15000 m (50000 ft)

Shock and Vibration: Meets IEC 68, CSA 22, 151, standards.

Electrical Interference: Conducted VDE 0871 Class B, FCC class A; radiated VDE 0871 class B, FCC class A

Size: 535 mm x 215 mm x 585 mm (w x h x d); 21" x 8.5" x 23"

Weight:

48 ch configuration; 22.2 Kg (49 lbs)

96 ch configuration; 23.1 Kg (51 lbs)

Ordering Information

Models*

January 1989 prices

PM 3655/203 Logic analyzer, 24 channels	$4900
PM 3655/503 Logic analyzer, 48 channels	5900
PM 3655/703 Logic analyzer, 72 channels	7900
PM 3655/903 Logic analyzer, 96 channels	9900

**Note: Each model includes a complete set of logic pods and one clock and qualifier pod.*

Options**

PM 3655-01 RAM memory expansion to 640 kbytes; (no slots used)	350
PM 3655-02 Second Floppy Disk	450
PM 3655-03 20 Mbyte Hard Disk; (½ slot used)	850

***Options -02 and -03 are mutually exclusive*

Accessories

PF 8650 24 channel state/timing expansion module	2400
PF 8600 12 channel logic pod	350
PF 8601 Clock/qualifier pod	350
PF 8610 Personality adaptor and disassembler for 8085	1000
PF 8611 Personality adaptor and disassembler for 6800	1000
PF 8612 Personality adaptor and disassembler for 6809	1000
PF 8613 Personality adaptor and disassembler for 6502	1000
PF 8614 Personality adaptor and disassembler for Z80	1000
PF 8620 Personality adaptor and disassembler for 68000	2000
PF 8624 Personality adaptor and disassembler for 8068/8088	2000
PM 8819/30 50 miniclips (red)	75
PM 8819/90 30 Miniclips (black)	on req.

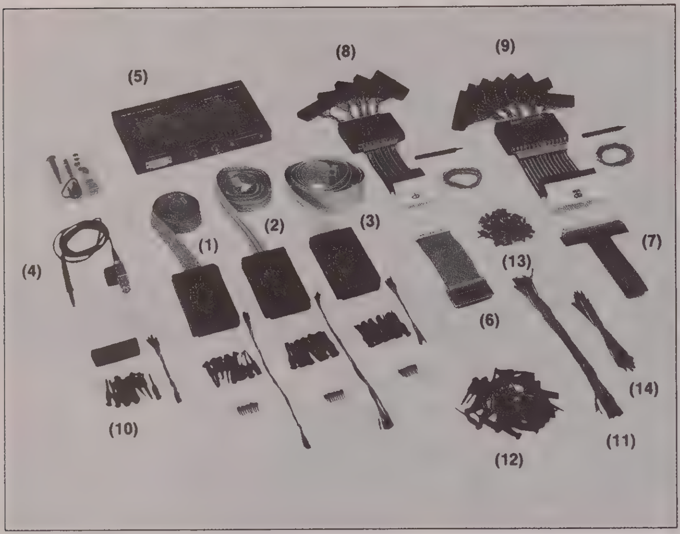
Service & Support

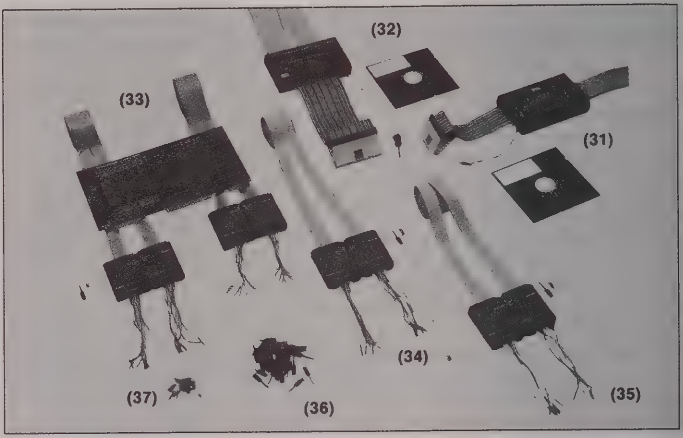
Warranty

One-year product warranty. (See page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see page 491.

Accessories





Accessories for PM 3565 & PM 3570

(3)	**PM 8826**	16-Ch Dual Timing Probe Pod	$1000
	PM 8827	132-Ch Single Probing Adapter	500
(5)	**PM 8811/001**	Serial Data Pod	1195
	PM 8815/40	Flat Cable & 40-pin DIL Clip [1]	150
(6)	**PM 8815/45**	Low Profile Connector to 40-pin DIL Connector	150
	PM 8815/48	Flat Cable & 48-pin DIL Clip	150
	PM 8815/64	Flat Cable & 64-pin DIL Clip	200
	PM 8815/65	Low Profile Connector	
(7)	**PM 8815/68**	Pin Grid Adapter (68000/68010) 68 pin	75
	PM 8815/70	Pin Grid Adapter for 80286	750
	PM 8815/72	Pin Grid Adapter 68020/114 pin-Grid Front End of 68020	750
(8)	**PM 8817/40**	Personality Adapter for 40-pin DIL	500
(9)	**PM 8817/64**	Personality Adapter for 64-pin DIL	500
(8,9)	**PM 8817/xx**	Range of Personality Adapters for particular microprocessors	500
(10)	**PM 8819/00**	Extension Kit	75
(11)	**PM 8819/10**	54 Colored Leads (for PM 8820/8810)	75
(12)	**PM 8819/20**	35 Measuring Clips (black)	75
(13)	**PM 8819/30**	50 Mini Measuring Clips (red)	75
	PM 8819/40	54 Colored Leads (PM 8825 at 50 MHz, 15 cm)	75
	PM 8819/50	54 Colored Leads (PM 8825 at 300 MHz, 6 cm)	75

[1] part of accessories 8 and 9

Accessories for PM 3655

(34)	**PF 8600**	12 Ch Logic Pod	300
(35)	**PF 8601**	Clock/Qualifier Pod	350
(31)	**PF 8610**	Personality Adapter & Disassembler 8085	1000
	PF 8611	Personality Adapter & Disassembler 6800	1000
	PF 8612	Personality Adapter & Disassembler 6809	1000
	PF 8613	Personality Adapter & Disassembler Z80	1000
(32)	**PF 8620**	Personality Adapter & Disassembler 68000	2000
(32)	**PF 8624**	Personality Adapter & Disassembler 8086/88	2000
(33)	**PF 8650**	24 Ch State/Timing Expansion Module	2400
(37)	**PM 8819/30**	50 Mini Measuring Clips (Red)	75
(36)	**PM 8819/90**	30 Mini Measuring Clips (Black)	

Board Testers & Troubleshooters

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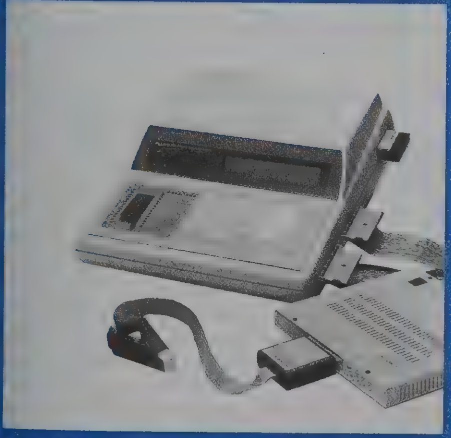
Page 173 9010A

Page 165 9100A

Page 172 9132A


Page 162 900

Most electronic equipment designed in recent years uses microprocessors. While this component makes it possible to design very sophisticated equipment at a low cost (such as personal computers), there are drawbacks in troubleshooting and repairing microprocessor-based circuit boards.

Astute manufacturers of electronic products know that the long-term success of their products depends on effective diagnostics in production testing, and fast, economical repair and service. That's why Fluke developed the innovative 9000 Series Micro-System Troubleshooter. It has proven to be a very cost-effective solution for hardware debugging, testing and servicing of microprocessor-based equipment, using any one of over 50 different types of microprocessors.

For easy and quick testing of board kernels (the heart of the board), Fluke is proud to introduce its new 90 Series. Easy to learn and use, the 90 Series features a very low price.

For higher levels of automated testing and troubleshooting in production lines or in service depots, Fluke offers the 9100A Digital Test System, today's most sophisticated, most capable emuative board tester.

Fluke's solutions go further, too; the 900 Dynamic Troubleshooter provides quick and accurate fault isolation to the component level; anywhere on the Unit Under Test. No detailed UUT knowledge or documentation is required. It can be used to complement any functional test or self test procedure to pinpoint the fault to a component.

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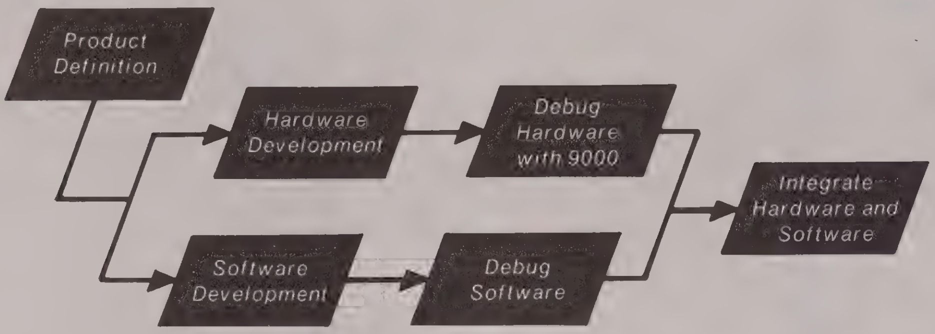
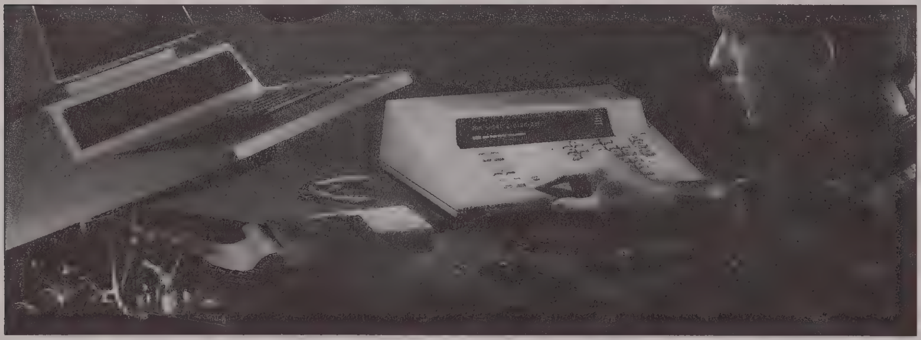
Interface Pods 178
Options Compatibility 182

Product Development

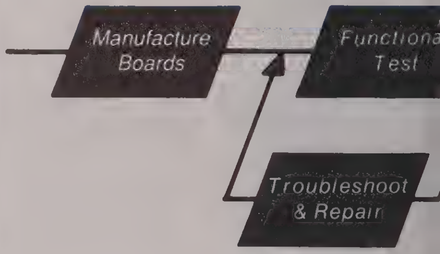


Prototype Debug

The **9010 Microsystem Troubleshooter** is the ideal tool for verifying hardware prototypes independent of system software. The low cost 9010A controls your board through the microprocessor kernel, allowing fast debugging without writing assembly code. Even with dead boards!



Manufacturing Board Test & Troubleshooting



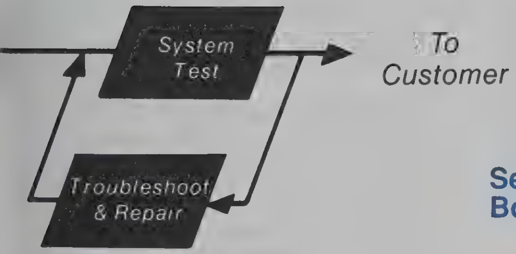
Functional Board Test

For medium and low volume board test, the **9100A Digital Test System** is the most productive, cost effective tester available. With its low capital cost, fast programming, and powerful test algorithms the 9100A offers test automation in an affordable, flexible package. Emulative Testing, at the heart of the 9100A, is the preferred technology for today's digital boards. The small size and low cost of the 9100A allows manufacturing test operations to be implemented in the most efficient manner, with dedicated product work cells, fast set-ups for small quantity production runs, and networking for data collection and process control. Software that is transportable to additional testers allows test capacity to grow incrementally as your test volume grows.

Fluke Board Testers

Highest Return For Your Test Investment. Fluke has been manufacturing electronic products for 40 years, and we are experts at testing and servicing our own high quality, high technology products. We offer this experience to you with innovative test equipment that is dramatically lower in price than traditional automated test equipment, while staying ahead of modern test requirements. Compare our board test products to any other, and you will find your highest R.O.I. comes from Fluke.

Plus, Common Test Philosophy for Product Development, Manufacturing, and Service. Fluke board testers break away from traditional techniques and limitations. For your products to compete, you require an integrated approach to design, manufacturing, and service. Fluke board testers offer test commonality between departments: tests designed in product development can be enhanced and used by production test, and then transferred to your service department. Advanced test software combined with lower cost hardware allows you to implement a corporate test strategy to meet your needs.



Troubleshooting

Fast, accurate board troubleshooting is where the **9100A Digital Test System** really stands apart from any other board tester. Sophisticated Guided Fault Isolation (GFI) algorithms speed even inexperienced technicians to faulty nodes. Faults that would take hours to locate using an oscilloscope or logic analyzer take just minutes with the 9100A. Advanced test development software lets you, the test engineer, concentrate on writing powerful test programs quickly.

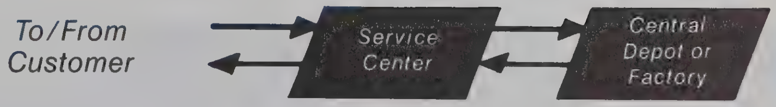
For a non-programmed solution, the **9010A Microsystem Troubleshooter** offers the same powerful Emulative Test techniques as the 9100A in a keystroke controlled package. The 9010A is a tool for the experienced technician, who can combine his knowledge of the Unit Under Test with the direct control of the 9010A.

The **90 Series** is a unique instrument for service technicians and design engineers with full-featured fault-finding capabilities. It is specifically designed for use in service departments for benchtop component-level testing and verification; and is also suited for engineering prototype testing, field monitoring applications and technician training.

Emulative testers may be complemented with the 900 Dynamic Troubleshooter which offers quick and accurate fault isolation to the component level. It tests a digital IC on the Unit Under Test (UUT) by comparing its performance to that of a known-good reference device and automatically analyzes the performance of the device under test as it operates in the circuit. It captures timing, intermittent, as well as static faults. It can test standard digital components from SSI to VLSI, (D)RAM and ROM, as well as custom parts like PALs, ASICs and gate arrays up to 28 pins.

When a stimulus is available for the unit under test, the 900 Dynamic Troubleshooter can troubleshoot non-microprocessor-based UUTs as well.

Service
Board Test & Troubleshooting



Centralized Repair

When repair is centralized , the **9100A Digital Test System** offers the same advantages to service as to manufacturing: cost effective automated test and troubleshooting for medium volume, large variety board test operations. If large board float inventories are a problem, consider using 9105As at your service centers as functional, Go/No-Go testers. The good boards swapped out of your customer's equipment can be identified and returned to use, while the bad boards are sent to your central site for repair.

Decentralized Repair

For fast customer response and minimal spare board inventory, board repair needs to be close to your customer site. The **9010A Microsystem Troubleshooter, the 900** and the **90 Series** offer the test and troubleshooting capabilities you need at prices you can afford to equip each service center. For an automated solution, programs written on the **9100A Digital Test System** can be implemented on the lower cost **9105A Digital Test Station.** Test software written at the factory or central service headquarters is distributed to the field on the execute only 9105A, offering the control and efficiency of centralized test programming with the low board float of decentralized repair.

900

NEW

900 Dynamic Troubleshooter

- Tests IC at speed while in circuit
- Supports standard and custom devices
- No test programs required
- Detects intermittent timing faults
- Softkey menu for easy operation

The Automated Troubleshooter for Dynamic Testing of ICs, at Speed, While Still in Circuit

The 900 Dynamic Troubleshooter is Fluke's newest addition to the board test product line. It's a powerful diagnostic tool for service and repair of digital circuits. The 900 provides you with a simple but effective means of testing ICs operating at speed, while still in circuit. Unlike other in-circuit testers, the 900 does not force any artificial signals into the UUT, nor does it try to backdrive devices or guard points. Yet with the 900, you can quickly isolate faults down to the individual component. No more "shotgun" attempts to repair a board! And because the 900 uses a proprietary comparison testing technique, you can pinpoint faults with little or no programming, and with minimal knowledge of the board under test or the individual components.

The Fluke 900 tests standard digital components, from SSI to VLSI, including (D)RAM and ROM, as well as custom parts such as PALs, ASICs, and gate arrays up to 28 pins. Components can be tested both IN & OUT of circuit. But no special software, device descriptions or fixturing is required.

The 900 is not a universal solution, but rather a powerful tool that helps a technician isolate faults rapidly and accurately. A technician can begin using the 900 with very little training. And the 900 can be used as a stand-alone tool, or as a complement to testing with hot mock-ups or emulative testers, such as the Fluke 90, 9010 and 9100 family of digital testers. One of these emulative testers can be used to quickly test the kernel of the UUT, and localize any fault to a subsection of the UUT. The 900 can then be used to isolate faults down to the defective component. A 9010A or 9100A can also be used to stimulate a board that is otherwise dead, so the 900 can then test ICs on the board while active.

A complete 900 tester includes:

- The main unit with graphic display, operator keypad, RS-232 interface port, and ZIF socket for a reference component;
- An interface buffer with high-speed signal conditioning to capture measurements from your board under test. No special pods or adaptors are required.
- A starter assortment of clips to attach to various sizes of ICs, from 14 to 28 pins; J-lead SO version SMDs are also available.
- Nonvolatile memory cartridges for storing predefined board test sequences, plus patch leads and antistatic reference device tray.

The Power to Solve Even the Toughest Problems

With its combination of unique features, the Fluke 900 excels at diagnosing faults in a wide variety of applications. Among these are:

Real-Time Component Tests While In-Circuit

The 900 tests the Device Under Test (DUT) as it operates in-circuit, in real time, at data rates of up to 20 MHz. The 900 does not backdrive the DUT or guard points, nor force any artifical signals into the UUT. Rather, it unobtrusively monitors the DUT while operating, and compares the DUT's behavior with that of a known good part. The 900 will detect a failure if the response of the DUT differs by greater than 20 nsec from the response of the reference part. The timing tolerance can be adjusted with 10 nsec resolution to compensate for normal circuit loading conditions.

Tests Without Software Programs

The 900 tests digital ICs by comparing a known good reference chip to the DUT on the board. Just plug in your reference chip and clip onto the DUT. Since the reference chip serves as a model for the test, the user does not have to write any device timing descriptions or test software. The user can optionally specify a test sequence which lists the preferred order in which ICs are to be tested on a board; any adjustments to the setup parameters for each IC can be added. These test sequences can be stored on nonvolatile memory cartridges.

Detects Intermittent & Thermal Faults

The 900 continuously monitors every pin on the DUT, asynchronously, without clocking or sampling. This insures that intermittent or one-shot faults will be captured, with the same 10 nsec resolution as timing and static faults. The user can choose the duration of a test, so the 900 can be set to capture elusive intermittent faults.

Tests Even When You Have No Documentation

Incomplete or even incorrect documentation is a common problem with today's constantly changing designs. But the 900 can still be applied when limited device descriptions or no detailed schematics are available: known good parts essentially define the tests for components in the UUT. And since reference parts define the test for each chip on the UUT, the 900 can readily test a private-labelled, or proprietary custom IC – even when extensive documentation is unavailable. Of course, a known good board will help determine if any timing resolution adjustments are necessary for individual ICs on the UUT.

Isolates Faults in "Untestable" Circuits

Some testers have difficulty with components in "untestable" circuits, such as ICs wired into loops, or ICs which have internal memory. The 900 readily handles many such common testing problems:

Hardwired Inputs or Outputs: The 900 tests ICs when input leads are tied together, or strapped to supply. Both the reference device and the DUT will see the same data on their respective input pins, and the 900 accepts that as a normal circuit condition.

Components with Internal Memory (e.g. ICs with latches or counters). The 900 has built-in synchronization routines to put the reference device and the DUT in the same state when the test begins, even if the DUT's internal memory cannot be initialized because control pins are strapped in an inactive state.

Feedback Loops & Apparent Multiple Faults. Fault isolation in feedback loops can be difficult, since the fault seems to be everywhere at the same time. The 900 measures and displays the amount of time elapsed until the fault occurs, with 40 nsec accuracy. By identifying the earliest device to fail, the 900 can be used to isolate the defective IC in a loop.

Bus Devices. The 900 readily tests bus devices, since the 29-channel Gate function can be used to insure that actual testing is performed only when the DUT is active on the bus.

Short Circuits and Open Circuits. The 900 monitors every pin on the DUT for any activity or for activity at a specifiable frequency, and flags any pin when there is no activity – whether due to a shorted node or an open lead. A conventional shorts finder could be used to pinpoint the actual physical location of a short.

Memory Testing. The 900 treats memory devices, even DRAM, like any other logic device. Since all data and timing signals are replicated, the 900 will perform full tests on memory chips. (RAM chips must have memory locations written before being read, so the DUT and reference device will have the same data.)

Still More Capabilities

The Fluke 900 has several other features which make it an even more effective troubleshooting tool:

Built-in Frequency Counter. The 900 can measure signal activity on all of the DUT pins, plus one additional external node – at up to 25 MHz, accurate to within 0.5%.

User-definable Trigger. A two-word trigger function can be defined from a combination of 28 signals on the DUT's leads plus an external node, to start a test (similar to a conventional logic analyzer). Trigger event detection is a powerful diagnostic tool: it helps isolate the occurrence and then location of a fault.

User-definable Gate. Alternatively, a one-word gate function can also be defined from a combination of the DUT's pins plus an external node. This controls when comparisons are actually made between the DUT and the RD, such as in testing a bus driver.

User-definable Test Cycle. The 900 can be set to issue an automatic RESET signal to the UUT at the start of the test for each device. The user can also set the duration and timing of the reset pulse, relative to the comparison test, as well as the length of the overall test.

Nonvolatile RAM Cartridges. Memory modules, 32K bytes, can be used to hold test results, or predefined test sequences.

RS-232C Interface. This supports both software and hardware handshake protocols, and is programmable with data rates up to 19,200 baud. An optional IEEE-488 interface is also available.

Automatic Logging of Test Results. The 900 can be set to automatically save detailed test results on a memory pack, or to a device connected to one of the remote interfaces.

Friendly Operator Interface. The 900 has a softkey based menu-driven interface which supports operation of the unit, plus complete creation and editing of test sequences.

Complete Product Training and Support. So that you can get the maximum use out of your 900 right away, Fluke offers a hands-on in depth training course on troubleshooting with the 900. You are entitled to a free certificate for this two day course, with the purchase of a 900. Your account manager has the details. See page 476 for more information on Fluke's training courses.

Theory of Operation

The Fluke 900 operates on the principle of Dynamic Hardware Reference Comparison. This means that the *real-time* operation of the DUT is compared to that of a known good Reference Device (RD). Comparisons are made while the DUT is operating at speed, for data rates up to 20 MHz (not clock rates).

The 900 continuously monitors the DUT and RD to determine which pins are inputs and which are outputs at any given moment; tri-state and bi-directional pins are handled automatically. The 900 is thus able to apply to the input pins of the RD the same signals as are on the input leads of the DUT while still operating in circuit. Simultaneously, the 900 checks for any differences in the outputs of the two chips, and flags these as errors; discrepancies down to 10 nsec are detected.

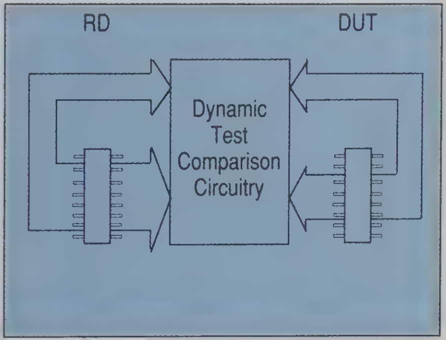
Some activity on the UUT is necessary in order for the 900 to test the performance of individual ICs. Since the 900 measures and displays the test time elapsed up to when a fault occurs, it can test even boards which crash after just a few machine cycles. In some cases, an emulative tester, such as the Fluke 9010 or 9100, or else a hot mock-up, can be used to stimulate activity on the UUT.

While the 900 isolates faulty components in circuit, it does not backdrive devices or guard points like other in-circuit testers. Instead, it monitors the signals coming into the DUT's pins, and replicates these on the RD; outputs are compared in real time, as the chips operate at normal clock speed.

Of course a RD will not experience the exact same loading as the DUT does in circuit. This can result is slight differences in the response times of the RD and the DUT. The 900 compensates for this by using a specifiable value for the acceptable difference (or fault window) in response times for the two chips – adjustable from 10 nsec on up, in 10 nsec steps.

Logic threshold levels can also be specified, at any level between 0 and 5 volts, with a resolution of 100 mV.

The fault window and logic threshold voltage levels together define a Performance Envelope against which the DUT is compared to the RD.



To determine the Performance Envelope for various DUTs, a known good board should first be examined. Any ICs on this good board for which the acceptable fault window and/or logic voltage levels differ from the regular setting should be noted. These test adjustments can be stored in nonvolatile RAM cartridges, as part of a test sequence for the UUT.

900

Test sequences can be written for any UUT. Rather than complicated software programs, these test sequences are simply a list of the order in which to test the devices on the UUT, along with any adjustments to the Performance Envelope, and any user-specified trigger or gate words. Comments or instructions to the operator can be included here, for each step in the test sequence. The operator can work through the test sequence in the specified order, simply by pressing the NEXT key for each step, or can jump around within the sequence to a particular component, to take advantage of his experience.

Specifications

Power: 115/230V ac, 47 to 63 Hz, 100W
Storage Temperature: -40°C to +70°C
Operating Temperature: 0°C to +50°C
Size:
  Main Unit: 12 x 15 x 3.5 in (30.5 x 38.1 x 8.9 cm)
  Interface Buffer: 8 x 8 x 0.75 in (20.3 x 20.3 x 1.9 cm)
Cable Length: 48 in (122 cm)
Weight: 12 lb (5.44 kg)

Electronic Parameters

Devices Supported: Digital components up to 28 pins, SSI to VLSI capable of driving one LS load. N, S, F, LS, AS, ALS, HC, HCT, ACT, FACT, Open Collector TTL, 4000, I4000 CMOS optional.
Custom Components: PAL, HAL, PLA, FPLA, and Gate Arrays.
Memory: Static and dynamc RAM, ROM, PROM, EPROM, FIFO
Fault Discrepancy Resolution: 20 to 200 nsec (adjustable in 10 nsec increments)
Device Initialization and Synchronization: Times programmable from 10 to 9990 msec; test time from 1 msec to 9990, or continuous
Frequency Counter Measurement: To 25 MHz, <.5% 20% min. duty cycle for frequencies >20 MHz
DUT: Tested at data rate of up to 20 MHz
Minimum Pulse Width: 20 nsec
Minimum Slew Rate: 10V/µsec
Pin Loading on UUT: 10 KΩ @ 30 pf
Inputs Protected: To ±25V
Device Logic Levels: 0 to 5V, in 100 mV steps
Trigger Circuit: User-specifiable, two word of 28 pins on the DUT plus one external node; test cycle begins when trigger condition(s) met
Gate Circuit: User-specifiable, one word of 28 pins on the DUT plus one external node. Comparison test is performed ony while gate condition is True.
Trigger or Gate: Can be used at any on time
Reset Circuit: Programmable to be positive or negative; is tri-stated when not active. Position of Reset pulse is programmable relative to test cycle, from 0 to 9990 msec before/after start of comparison test, with 100 msec increments. Pulse duration is 100 msec
Can use either internal power or from the UUT:
Internal: Supplied from 5 V source;sink/source 50 mA @ .8/4.2V
External: Supplied from UUT (2 to 15V); sink/source 50 mA @ 0.8/V_{ext} -0.8V

Ordering Information

Model

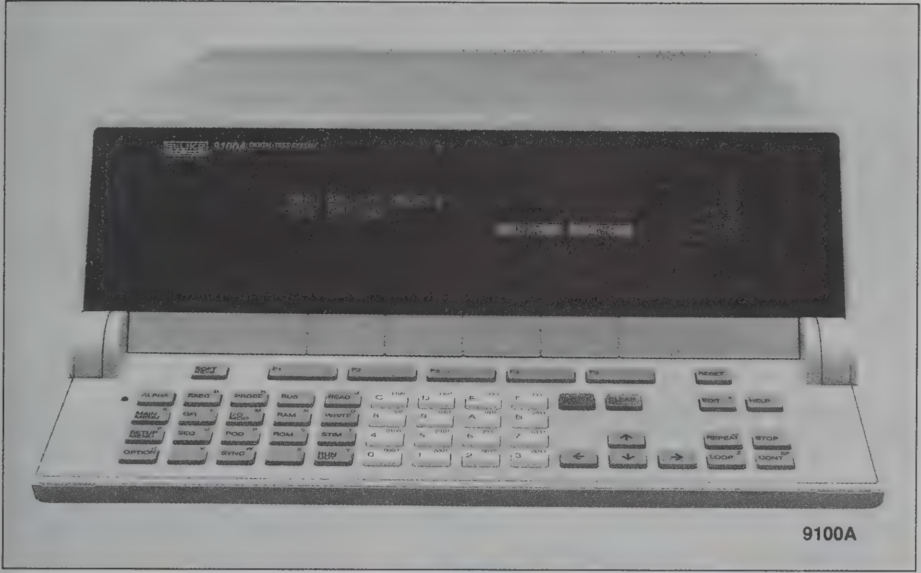
January 1989 prices

900 Dynamic Troubleshooter $7990
  Includes: 900 Main Unit
  Interface Buffer
  Three Test Clips:
  Y900-16D 16-pin, 0.3" Test Clip
  Y900-24D 24-pin, 0.3" Test Clip
  Y900-28D 28-pin, 0.6" Test Clip
  Y900-001 Data Cartridge
  Y900-005 Set of Patch Cords
  Y900-003 RD Tray & Cartridge Holder
  User's Manual
  Power Cord
  See your Fluke Representative for details on training

Options & Accessories

Y900-001 Data Cartridge	120
Y900-002 Data Cartridges, set of 3	360
Y900-003 RD Tray & Cartridge Holder ..	30
Y900-004 RD Tray & Cartridge Holder, 3	30
Y900-005 Patch Cords & Clips, set of 5	100
Y900-006 Carrying/Shipping Case	400
Y900-8D Test Clip, 8 Pin Dip, 0.3"	100
Y900-14D Test Clip, 14 Pin Dip, 0.3"	100
Y900-16D Test Clip, 16 Pin Dip, 0.3"	100
Y900-18D Test Clip, 18 Pin Dip, 0.3"	100
Y900-20D Test Clip, 20 Pin Dip, 0.3"	120
Y900-24D Test Clip, 24 Pin Dip, 0.3"	120
Y900-24DW Test Clip, 28 Pin Dip, 0.3" ..	120
Y900-8S Test Clip, 8 Pin S.O.I.C., 0.1" ..	140
Y900-14S Test Clip, 14 Pin S.O.I.C., 0.1"	140
Y900-16S Test Clip, 16 Pin S.O.I.C., 0.1"	140
Y900-16SW Test Clip, 16 Pin S.O.I.C., 0.2"	140
Y900-18S Test Clip, 18 Pin S.O.I.C., 0.2"	140
Y900-20S Test Clip, 20 Pin S.O.I.C., 0.1"	160
Y900-24S Test Clip, 24 Pin S.O.I.C., 0.1"	160
Y900-28S Test Clip, 28 Pin S.O.I.C., 0.1"	160

RS-232



9100A

9100 Series Digital Test System

- Emulative Board Test: Test microprocessor-based digital circuitry from the microprocessor kernel outward
- Automated Functional (GO/NO GO) Tests and Guided Fault Isolation (GFI) Test
- Integrated program development environment
- Automatic functional tests of µP kernel
- Automatic generation of GFI decision tree
- Support for over 50 microprocessors
- I/O module and single point probe to "close the loop" in measurement or stimulus
- FREE Applications and Programming Courses with purchase!

The 9100 Series is the top of the line in Fluke's family of digital testers and troubleshooters. It is designed for fast, cost-effective automation of your test and troubleshooting procedures for microprocessor-based digital circuit boards.

Included in the 9100 Series are two testers: the 9100A Digital Test System, which can be used both for developing test software and as a stand-alone test station, and the 9105A Digital Test Station, an execute-only tester that can be used to execute programs developed on the 9100A.

The 9100A offers fast and easy development of functional test and troubleshooting programs which stay ahead of the increasing complexity of digital boards. Test program design is highly automated, guiding the test or service engineer through the development process. Combined with new state-of-the-art test hardware, complete digital board test and repair solutions can be implemented in record time.

The 9105A Digital Test Station turns a power ful test solution into an economical one. At very low cost, the 9105A delivers powerful automated tests, developed on the 9100A, to the factory floor or service center. An easy to use interface allows any operator to quickly test and troubleshoot. Guided Fault Isolation (GFI) programs isolate faults to the node level, so both functional testing and troubleshooting can truly be automated. The 9100A and 9105A combine to offer unmatched power, flexibility, and economy to factory board test and service center repair.

Both testers interface with the unit under test (UUT) through the following hardware components:

- A microprocessor or memory interface pod that emulates the microprocessor actions on the UUT.
- A single-point probe to measure UUT responses at any node within or beyond the microprocessor kernel; the probe can also provide stimulus at any node.
- I/O modules which provide stimulus and gather response at up to 160 nodes simultaneously.

Test Techniques For Every Part of the Board

The 9100 Series can detect and isolate faulty components on all types of microprocessor-based circuit boards. Types of tests include built-in functional testing of the microprocessor BUS, RAM, and ROM. The 9100 Series will also isolate faults in both synchronous and asynchronous circuitry and, through its interface pods, can emulate a broad range of microprocessor chips. Together, these capabilities let you test your products more thoroughly and with a higher degree of confidence than ever before – for prototype debug, during production, and in the field.

Emulative Board Testing

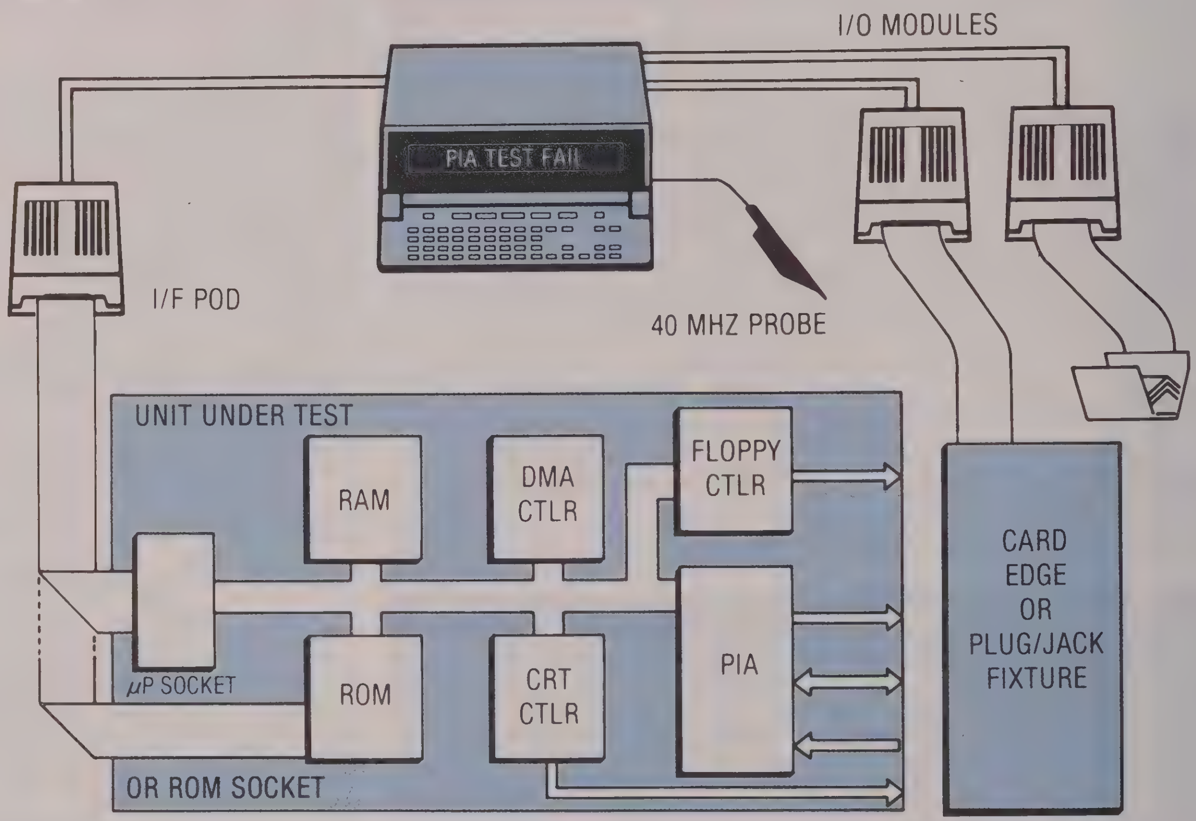
At the heart of Fluke's approach is a technique known as emulative board testing – so called because it involves either microprocessor or memory emulation. The function of any emulation pod is to provide an interface between the circuit board under test and the test mainframe, adapting the general architecture of the mainframe to that of the specific microprocessor on the circuit board under test.

These emulative board test techniques are preferred by board manufacturers the world over because they are the only techniques that test a board from the "inside out." By troubleshooting the kernel circuitry first, you have a solid base for testing the remainder of your board. Consequently, you locate more faults, more quickly, than with any other approach.

Pods are available to support more than 50 microprocessor chips, including the 80386 and 68020. All existing Fluke interface pods can be used with the 9100 Series.

Microprocessor interface pods. To emulate the board's microprocessor, you select the microprocessor interface pod that corresponds to the microprocessor on the board. In addition to containing its own microprocessor, each pod has its own RAM, ROM, and I/O, making it a complete kernel. The pod replaces the board's microprocessor, allowing the pod to control all bus-related devices on the board. Plugging in the pod also causes the clock circuit of the board under test to be channeled to the pod's microprocessor, so that tests can be performed with the board running at its normal speed. For a complete listing of available microprocessor interface pods, please refer to page 178.

Memory interface pod. The 9132A Memory Interface Pod is the newest addition to Fluke's family of interface pods. It features the capability to be reconfigured for additional microprocessors by simply replacing a plug-in personality module. The 9132A provides the same test capabilities of previous pods, including READS, WRITES, RAM test, etc., and uses the same user commands so operation is identical. The difference is in how UUT connections are made, with interfacing through the UUT ROM and via a sync module. For more information on Fluke's memory interface pod, please refer to page 172.



COMPLETE DIGITAL FAULT COVERAGE

Built-in BUS, RAM, and ROM tests. Using the pods, you can quickly execute the 9100 Series' built-in BUS, RAM, and ROM test routines. Because these circuits operate the same way on all microprocessor-based boards, you can run these tests as soon as you plug in the pod, without writing any code at all. At the conclusion of each test, the system reports its findings to the operator via specific fault messages.

Functional Testing Beyond the Kernel

I/O modules for rapid fault isolation. One of the innovations offered with the 9100 Series is the new type of circuit interface device for node-oriented troubleshooting: the I/O module. This module, which lets you test all pins on a chip at once, provides a quick means of detecting and isolating faults for signals up to 10 MHz. It works with both synchronous and asynchronous circuitry, on or off the bus. And, because you can use up to four I/O modules at a time, you can test as many as 160 pins simultaneously.

Modules may be clipped directly over the chip via DIP or SIP clips, available in configurations ranging from 14 to 40 pins. Or you can use the 9100 Series 20-line flying lead module to develop your own custom connections, connecting the tester to the board edge or a customized test fixture.

The I/O module lets you use a variety of test techniques. You can use it to drive a node high or low or to stimulate it with a string of data patterns. It can also gather a wide range of response data, including taking a node's signature, sensing its logic level, and measuring activity on a node through frequency measurements or event counting. Built-in clock connectors let you synchronize the module to an external clock when troubleshooting asynchronous circuitry.

Card Edge Fixture Kit

The Card Edge Fixturing System profices a fast, reliable way to interface the Fluke 9100A and 9105A Digital Test Systems to any digital circuit board with a card edge connector. The Card Edge Fixture is ideal for accessing signals at the card edge and for testing boards with an external bus.

Vector Output I/O Module for Card Edge Stimulus

New for 1989, this I/O Module offers high speed st under control of the 9100A. It can provide real-time signals to the UUT card edge, allowing limited bus emulation with handshake input, pattern looping, and dynamic tri-state control to each bit. Modules are 40 bits wide, and up to four modules can be used at one time.

Single-point probe for high-frequency signals. You can use the single-point probe instead of the I/O module for higher-frequency signals, up to 40 MHz. You can also use it for parts of the board that cannot be accessed with an I/O module. Like the I/O module, the single-point probe can be used to drive a node high or low, to stimulate a node, and to gather various types of response data. It can take signatures, sense logic levels, and count events or frequencies. An external clock module provides leads for testing asynchronous circuitry.

Ways to Use the 9100A

Get as Much – or as Little – Automation as You Want

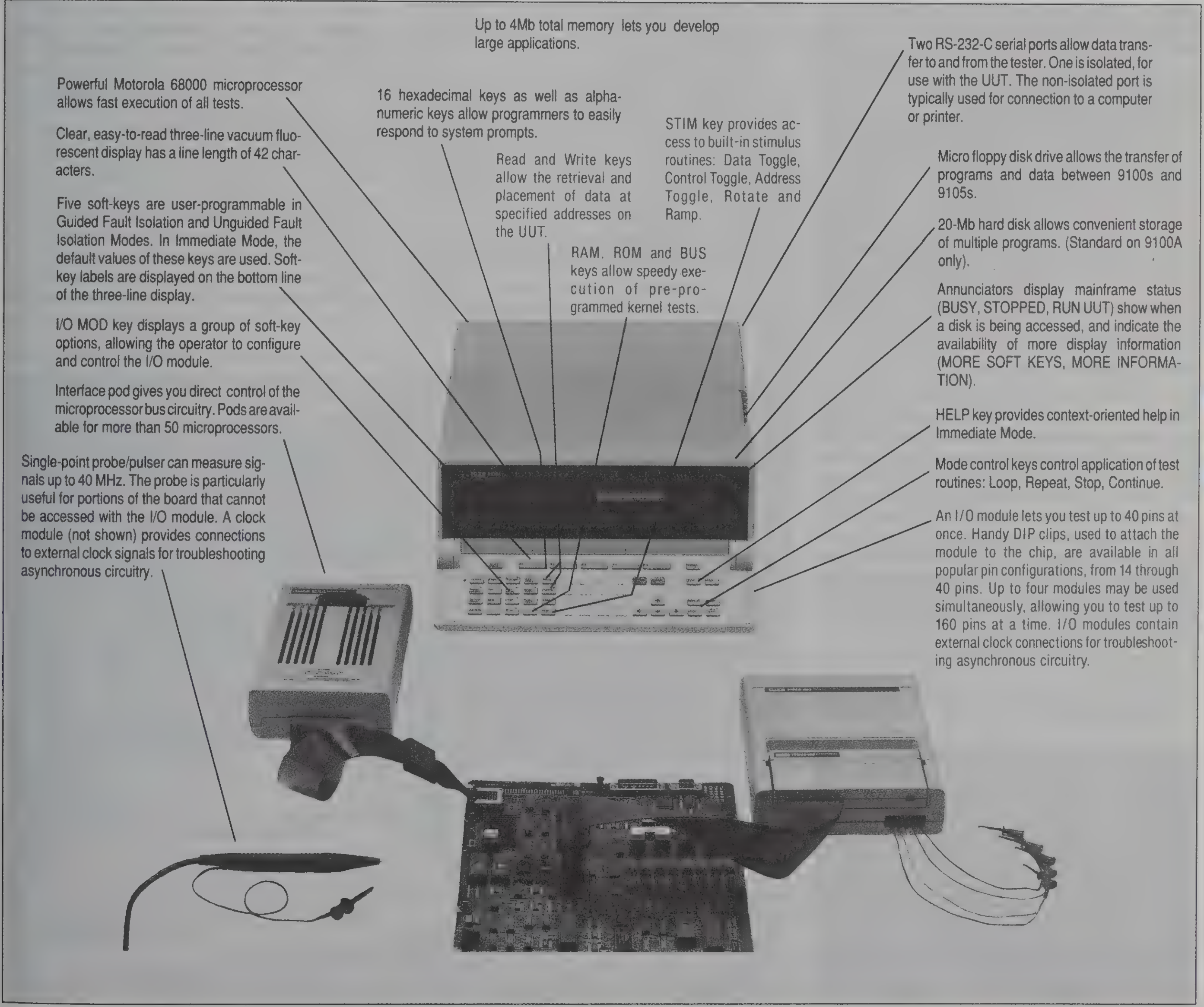
With the 9100 Series, you choose the degree of automation you want: Immediate Mode, for manual operation; Guided Fault Isolation, for automation of the troubleshooting process; or Unguided Fault Isolation, for semi-automated troubleshooting. If you do decide to automate, you'll find that many of the 9100 Series' special features – including the programming workstation, high-level programming language, and built-in Guided Fault Isolation decision tree – make the process easier and faster than you ever thought possible.

Manual Operation Lets You Start Testing Immediately

Immediate Mode lets you begin using your 9100 Series tester the first day you get it, without having to write any program code at all. With the pod connected, you can complete the built-in kernel tests. Then you can go on troubleshooting, using your knowledge of the unit under test to guide you.

Automatic Operation Guides the Operator From Start to Finish

For fully automated operation, the 9100 Series provides Guided Fault Isolation capability. In this mode, the operator enters no data and makes no



Powerful Motorola 68000 microprocessor allows fast execution of all tests.

Clear, easy-to-read three-line vacuum fluorescent display has a line length of 42 characters.

Five soft-keys are user-programmable in Guided Fault Isolation and Unguided Fault Isolation Modes. In Immediate Mode, the default values of these keys are used. Soft-key labels are displayed on the bottom line of the three-line display.

I/O MOD key displays a group of soft-key options, allowing the operator to configure and control the I/O module.

Interface pod gives you direct control of the microprocessor bus circuitry. Pods are available for more than 50 microprocessors.

Single-point probe/pulser can measure signals up to 40 MHz. The probe is particularly useful for portions of the board that cannot be accessed with the I/O module. A clock module (not shown) provides connections to external clock signals for troubleshooting asynchronous circuitry.

Up to 4Mb total memory lets you develop large applications.

16 hexadecimal keys as well as alphanumeric keys allow programmers to easily respond to system prompts.

Read and Write keys allow the retrieval and placement of data at specified addresses on the UUT.

STIM key provides access to built-in stimulus routines: Data Toggle, Control Toggle, Address Toggle, Rotate and Ramp.

RAM, ROM and BUS keys allow speedy execution of pre-programmed kernel tests.

Two RS-232-C serial ports allow data transfer to and from the tester. One is isolated, for use with the UUT. The non-isolated port is typically used for connection to a computer or printer.

Micro floppy disk drive allows the transfer of programs and data between 9100s and 9105s.

20-Mb hard disk allows convenient storage of multiple programs. (Standard on 9100A only).

Annunciators display mainframe status (BUSY, STOPPED, RUN UUT) show when a disk is being accessed, and indicate the availability of more display information (MORE SOFT KEYS, MORE INFORMATION).

HELP key provides context-oriented help in Immediate Mode.

Mode control keys control application of test routines: Loop, Repeat, Stop, Continue.

An I/O module lets you test up to 40 pins at once. Handy DIP clips, used to attach the module to the chip, are available in all popular pin configurations, from 14 through 40 pins. Up to four modules may be used simultaneously, allowing you to test up to 160 pins at a time. I/O modules contain external clock connections for troubleshooting asynchronous circuitry.

decisions. All necessary data – stimulus routines, reference lists, parts lists, known-good responses, and interconnectivity information – are contained in the program. The system tells the operator what nodes to probe and interprets all response data.

A key advantage of the system's Guided Fault Isolation capability is that all operators can benefit from the knowledge of your most experienced test engineers. Once your test engineers write the Guided Fault Isolation procedures, lower-level operators can execute them, saving you considerable labor costs.

Semi-automatic operation lets you choose the troubleshooting sequence

For semi-automatic troubleshooting, you can use the 9100 Series to perform Unguided Fault Isolation. This mode is like Guided Fault Isolation, except that the operator decides which node to probe. However, much of the manual activity is removed from the process, so you can troubleshoot more rapidly.

Once a node is selected, the appropriate stimulus routine is executed and the results of the stimulus are displayed. In this way, the operator guides the fault tracing procedure.

For experienced troubleshooters who prefer to follow their instincts rather than moving through a set troubleshooting sequence, Unguided Fault Isolation is the best technique.

The 9100A Programming Environment

(With Options -004, -005)

From its built-in back-tracing algorithm to its easy-to-use programming language, the 9100 Series lets you develop fully automated test and troubleshooting routines in a matter of days or weeks, as opposed to the months of development time required by many other systems.

Built-in GFI decision tree. The 9100A's specially designed back-tracing algorithm makes all the decisions about the troubleshooting sequence, allowing the programmer to enter the necessary information in simple data-base format. Information is stored in five kinds of files:

- Stimulus programs to test each node.
- Known-good responses to compare with UUT responses.
- A reference list relating the device number to the type of device.

- A parts library that explains the relationship of input pins to output pins.
- Interconnectivity data, indicating which devices and pins make up each node.

Special test language. The 9100A uses a programming language designed specifically for developing test and troubleshooting routines. Its command list incorporates all of the 9100 functions, program control constructs, and allowed variables, making it a well-rounded language for writing test programs.

Numerous features are designed into the program to make the programmer's job easier. Key among these are:

- Provision for default entries on most commands, simplifying the process of creating test routines.
- Built-in fault handlers that you can incorporate in your routines. (You can also choose to override these built-in fault handlers with custom-created ones).

You can write functional tests incorporating the microprocessor interface pod, I/O module, and probe. A debugger is provided with break point and single step capabilities to help you quickly locate any problems. You can also write administrative programs for example, to track board failures and the associated faulty components for future analysis.

Programming with the -004 is performed through an 80-column, 24-line CRT and a standard computer-style keyboard. The keyboard also includes nine soft keys with built-in functions to speed program development. The -005 includes the keyboard and a color video card to support a customer-supplied color monitor.

The 9105A Test Program Execution

The 9105A is an execute only version of the 9100A. It performs the same immediate mode operations as the 9100A and it will execute all programs written on the 9100A but you can not write programs with the 9105A. It has 2.0 Mbyte of RAM memory space and two floppy disk drives rather than a hard disk drive.

Customer Support Services

Fluke's support programs are designed to meet the needs of a wide variety of users.

Customer Training Applications course. The 9100 Series offers you a choice of test techniques as well as a variety of circuit-interface devices. The best choice for a particular situation depends both on the type of circuitry involved and on your objective (functional test, fault isolation, etc.) Fluke's product applications course shows you how to apply the 9100 Series to a wide range of circuits commonly found in microprocessor-based systems, so you can select the most appropriate test technique and interface device for each application.

Programming course. You will benefit from guidance in how to develop effective Guided Fault Isolation routines for different types of test and troubleshooting procedures. Fluke's programming course will help you get the most from the system's Guided Fault Isolation capabilities.

These courses are *free* to you when you purchase a 9100. Get the most out of the extensive capabilities of the 9100 with our in-depth, hands-on training courses.

System Integration. Fluke's contract consulting, programming and fixturing services offer still other options. You can contract with us for test software consulting help as you work on your own applications and programs, or you can have us simply develop programmed test and troubleshooting routines for you, customizing them to your particular products and procedures. Fluke's system Integration Group and Fluke Cooperative Services are available to help, from test fixturing to turnkey projects. Contact your local Fluke sales representative for a proposal.

Service

- **Worldwide network of technical centers.** Fluke's worldwide network of technical centers makes it easy for you to maintain and service your system, no matter where your operation is located.
- **Standard Warranty.** Your 9100 Series tester comes with a 90-day warranty, including both time and materials. Warranty service is available at any Fluke Technical Center, worldwide.
- **Extended Warranty Agreement.** All 9100A mainframe, options and accessories come with a 90 day warranty. A one year, renewable, Extended Warranty, covering all repairs with performance testing, including parts, labor and return surface freight costs.

This warranty will be discounted 10% if purchased with the instrument or if purchased prior to expiration of product warranty.

- **On-Site Service.** Even if you have an application where uptime is critical, Fluke can help. On-Site Service Agreements are available.

Software Support Agreement

A Software Support Agreement is a two year renewable agreement that provides for automatic software updates during the covered period. Software releases which enhance the speed or performance of system and/or programmer's system software operating on the 9100A and 9105A will be made available to Software Support subscribers at no additional cost. Manual revisions and updates are included.

In addition, Software Support subscribers have automatic membership in the 9100 Electronic Bulletin Board, an on-line users group. The Electronic Bulletin Board provides easy access to other 9100 users and experts at Fluke for the purpose of sharing information, TL/1 programs, papers, and more. Access to the Electronic Bulletin Board is available through a special toll-free 800 number, using any terminal, including a 9100A connected through a modem.

9100 Features

Mainframe: 20 Mbyte Hard Disk for program development and storage (9100A). Single (9100A) or Dual (9105A) 3.5 inch 640K-byte formatted MicroFloppy Drives for software loading, storage and copying. Up to 4 Mbytes or of internal RAM for program and data storage. Plug-in slots for 1 pod and 4 Parallel I/O Modules. Dual RS-232 Interfaces, one system referenced, one earth referenced.

Display: 3 line, 42 characters vacuum fluorescent dot matrix with graphics capability.

Keypad: User keyboard allows access to all functions. Seldom used functions are called with soft keys.

Built-In Tests

RAM: Allows selection of one of three possible tests for finding faults associated with RAM circuitry.

ROM: Reads ROM and computes CRCs and compares with stored CRC.

Bus: Checks the integrity of address, data and control bus.

Built-in Troubleshooting Functions

Read: Reads data from a specified location.

Write: Writes data to a specified location.

Toggle: Toggles a specified data, address or control bit.

Ramp: Ramps the data or address bus over all possible values with a specified starting value and a mask of bits to be ramped.

Rotate: Rotates right a specified starting data word through all possible bit positions.

Probe

Features: CRC signatures with external clock, start, stop, and enable; CRC signatures with external clock, start, and stop generated from a programmable number of clock pulses after start; CRC signatures with the clock from the pod sync; 24 bit transition counting using external start, stop, and enable; Frequency measurement to 40 MHz; Clocked 3-state logic level history using external clock, qualified with start, stop, and enable; Clocked 3-state logic level history using microprocessor pod sync clock; Asynchronous 3-state level history in all modes; Selectable thresholds for TTL, CMOS, and RS-232 levels; Three logic level indicators on the handheld probe body; Probe output drive for high, low or toggle synchronized to pod sync, external clock or free run; Probe response button to signal the mainframe to gather response data; Common lead fused for both the probe and clock module to provide ground fault protection, with blown fuse indication.

Software

Programming: The user creates and debugs test or troubleshooting procedures with the programmer's station option. This gives the user full access to a screen oriented editor and integrated procedure debugger. Test procedures generated on the 9100A can be transported and executed on other 9100A/9105A systems via the 3.5 inch micro-floppy media.

Language: The test language, called TL/1, is used by a test engineer to specify automatic test and troubleshooting procedures. TL/1 is an easily read high level language designed for complete control of the functional test and GFI test environment. The language includes the 9010A language testing concepts. Enhancements are provided in the area of fault handling, UUT initialization and interface to GFI procedures.

Edit/Debug: Procedure editing and debugging are integrated to present a unified means of testing and modifying procedures. The editor is screen oriented, and always provides the user with a current picture of the procedure being edited. The debugger provides many features such as break-point, tracing and access to variables by name.

Guided Probe/Clip Troubleshooting: A menu-driven software package makes it easy for a technician to specify node list information and accumulate signatures from a good UUT. During troubleshooting, this information is used to guide the operator. The operator is told where to place the probe or IC clip to track down the fault.

Executing: The procedure execution environment on the 9100A and the 9105A are identical. Procedures generated on the 9100A will also run on the 9105A. Procedures are transported from the 9100A to the 9015A on a 3.5 inch micro-floppy disk.

Manuals

Getting Started: A description of the parts of the 9100A/9105A, what they do, how to connect them, and how to power up.

Automated Operations Manual: How to run pre-programmed test or troubleshooting procedures.

Technical User's Manual: How to run built-in tests and manual or pre-programmed troubleshooting procedures.

Applications Manual: How to write test or troubleshooting programs using the 9100A's TL/1 programming language.

- TL/1 Reference Manual
- Programmers Manual
- Pod Supplemental Manual

Specifications

9100A/9105A Electrical Specifications

Single Point Probe Input Thresholds

TTL	CMOS	RS-232	
5.0V	5.0V	30V	GUARANTEED HIGH
2.6V	3.7V	3.2V	high or invalid
2.2V	3.3V	2.8V	GUARANTEED INVALID
1.0V	1.2V	-2.8V	low or invalid
0.6V	0.8V	-3.2V	GUARANTEED LOW
0.0V	0.0V	-30V	

Input Impedance: 70 kΩshunted by less than 33 pF

Data Timing for Synchronous Measurement
Maximum Frequency: 40 MHz

Minimum Pulse Width (H or L): 12.5 nsec
Minimum Pulse Width (tri-state): 20 nsec
Setup Times
Data to Clk: 5 nsec
Start, Stop or Enable to Clk: 10 nsec
Hold Time
Clk to Enable: 10 nsec
Clk to Start or Stop: 0 nsec

Data Timing for Asynchronous Measurements
Maximum Frequency: 40 MHz
Minimum Pulse Width (H or L): 12.5 nsec
Minimum Pulse Width Invalid (X)
TTL or CMOS: 100 nsec ±20 nsec
RS-232: 2000 nsec ±400 nsec

Transition Counting
Maximum Frequency: 40 MHz minimum
Maximum Count: 16777215 +overflow
Maximum Stop Count: 65535 clocks

Frequency Measurement
Maximum Frequency: 40 MHz minimum
Resolution: 20 Hz
Accuracy: ±250 ppm ±20 Hz

Output Pulser
High: >3.5V @ 200 mA for less than 10 µs; @ 1% duty cycle >4.5 @ 5 mA continuously
Low: <.8V @ 200 mA for less than 10 µs; @ 1% duty cycle <.4V @ 5 mA continuously

Clock Module Specifications
Input Threshold: 1.6V ±0.2V
Input Impedance: 50K shunted by less than 10 pF

Clock, Start, Stop, and Enable Input Speed
Maximum Repetition Rate: 40 MHz
Minimum Pulse Width: 12.5 nsec

RS-232 Interfaces
One isolated (system referenced)
One non-isolated (earth referenced)
Baud Rates: 110, 134, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200
Parity: Odd, even or none
Data Bits: 5, 6, 7, or 8
Stop Bits: 1, 1.5, 2
XON/XOFF (Ctrl-S/Ctrl-Q): Disable/enable
Clear to Send: Disable/enable
New Line: Carriage Return/Line Feed or Carriage Return

General Specifications

Operating Temperature: 5°C to 27°C 95% RH maximum (non-condensing); 27°C to 40°C; RH decreasing linearly from 95% to 50% (non-condensing)

Storage/Shipping Temperature: -20°C to 60°C; 8% to 80% RH, non-condensing; micro-floppy media limited to 5°C to 60°C, 8 to 80% RH non-condensing

Line Voltage: 90 to 132V ac 47 to 440 Hz; 180 to 264V ac 47 to 63 Hz

Power Consumption: Mainframe, 150W max; monitor, 50W max

Size:
Mainframe: 14.0 cm H x 34.3 cm W x 50.8 cm D (5.5 in x 13.5 in x 20.0 in) Monitor: 30.53 cm H x 33.53 cm W x 33.00 cm D (12.02 in x 13.2 in x 13 in) ASCII Keyboard: 5.02 cm H x 21.15 cm W x 47.2 cm D (2.0 in x 8.33 in x 18.51 in)

Weight:
Mainframe 8.26 kg (18.2 lb)
Monitor 8.44 kg (18.6 lb)
ASCII Keyboard 1.59 kg (3.5 lb)

Safety: Designed to meet the following safety standards: ANSI/UL 478, IEC 348, IEC435, and CSA 5568

Options

9100A-003 Parallel I/O Module

Features:

CRC signatures with Start, Stop, Enable clocked to pod or external clock.

CRC signatures with stop derived from a programmable number of clock pulses after Start. (with TL/1).

Enable can be derived from the external enable line, or from Pod Sync, or can be forced true.

Programmable slopes on clock, start, stop, and enable.

CRC signatures can be taken during overdrive.

Transition counter gated by external Start, Stop, and Enable.

Frequency measurements to 10 MHz.

Clocked level history using external clock; qualified with Start, Stop, and Enable.

Asynchronous level history.

Drive of any arbitrary pattern of 0, 1, or 3-state.

Comparison of any arbitrary 40 bit pattern with a programmable 40 bit pattern of 0s and 1s. True comparison available as a fault within TL/1 programs or as a message during immediate mode operation. The hardware signal (DCE), is also available on the outside of the I/O module.

Logic thresholds switchable between CMOS and TTL.

Family of DIP and SMT logic clip modules with response button to start response gathering.

Common lead fuse protection, for ground fault protection with blown fuse indication.

9100A-017 Vector Output I/O Module
Pins per Module: 40
Maximum Output Rate: 20 MHz
Maximum Pattern Depth: 8192 bits per pin
Input Specifications are the same as the 9100A-003 I/O Module.
Additional information will be available at introduction in March, 1989.

Electrical Specifications

Data Output Specifications:
Current, time >10 mS: ±200 mA
Current, <10 mS: ±2A
Pattern Rate, 1 module driven: 35 kHz
Pattern Depth, (1 module driven during 10 mS high current pattern drive mode): 256 patterns
Max current, per pin (driving high): 275 mA
Max current, per pin (driving low): 150 mA

Data Inputs: Input Impedance: 50 kΩ min

Input Thresholds

TTL	CMOS	
5.0V	5.0V	GUARANTEED HIGH
2.6V	3.8V	high or invalid
2.2V	3.3V	GUARANTEED INVALID
1.0V	1.2V	low or invalid
0.6V	0.8V	GUARANTEED LOW
0.0V	0.0V	

Clock, Start, Stop, and Enable Inputs:
Thresholds: Logic low 0.8V max; Logic high 2.0V min
Input Current: ±1 µA

Input/Output Overvoltage Protection: ±15V for one minute maximum, any pin, one at a time

Transition Counter
Max Frequency: 10 MHz minimum
Max Count (Transition Mode): 8388607 counts (+overflow)
Freq Accuracy (Freq Mode): ±250 ppm ±2 Hz

Stop Counter
Max Frequency: 10 MHz
Max Count: 65535 clocks

Clock
Max Frequency: 10 MHz
Min Pulse Width: 50 nsec

Timing for Synchronous Measurements
Max Frequency of Clock: 10 MHz
Data Setup Time: 30 nsec
Data Hold Time: 30 nsec
Minimum Pulse Width (Start/Stop/Enable/Clock): 50 nsec
Start Edge Setup Time (before clock edge, for clock edge to be recognized): 0 nsec
Stop Edge Hold Time (after clock edge, for clock edge to be recognized): 10 nsec
Enable Setup Time (before clock edge, for clock edge to be recognized): 0 nsec
Enable Hold Time (after clock edge, for clock edge to be recognized): 10 nsec

Data Timing for Asynchronous Measurements
Max Frequency: 10 MHz
Minimum Pulse Width (high or low): 50 nsec
Min pulse width (tri-state): 150 nsec

Data Compare Equal (DCE): Min pulse width of Data and Enable: 75 nsec

Y9100A-100 Card Edge Fixture Kit
Same type as "9100-003 Parallel I/O Mod"

Electrical Specifications
The electrical specifications of this fixture are defined by the electrical specifications of the 9100A I/O Modules and Interface Pods used with it. As long as the design guidelines outlined in the Card Edge Fixture Assembly Manual are followed, use of this fixture will not degrade the performance specifications of the I/O Modules or Interface Pods.

Mechancial Specifications
Size
Height: 14.4 cm (5.875 inches)
Width: 38.6 cm (15.75 inches)
Length: 46.6 cm (19.0 inches)

Ordering Information

Models

January 1989 prices

9100A/SYS Digital Test Programming System 9100A Digital Test System (see below) -004 Programmer's Station (see below) -003 Parallel I/O Module Y9100A-DCS Dip Clip Set (see below)	$24,500
9100A Digital Test System Probe with accessories Clock Module with accessories Manuals Volumes 0-3 System Software Disk #1 and #2 Master User Disk Y8091 10 Micro-Floppy Diskettes Troubleshooting Training Class	15,500
9100A-004* Programmer's Station Programmer's System Disk Monochrome Monitor Manuals Volumes 4 & 5 Video Card (monochrome config.) Video Cable Programmer's Keyboard One 5-Day Training Certificate	6,000
9100A-005* Programmer's Station Less Monochrome Monitor Programmer's System Disk Manuals Volumes 4 & 5 Video Card (color config. IBM color compatible) Programmer's Keyboard One 5-Day Training Certificate	5,800
9105A Digital Test Station Probe with accessories Clock Module with accessories Manuals Volumes 0-3 System Software Disk #1 and #2 Master User Disk Y8091 10 Micro-Floppy Diskettes	10,000

**If purchased separately for installation in a previously purchased unit, orders must be placed through a Customer Service Center. An additional installation charge will be added to the price.*

9100A/9105A Options†

9100A-003 Parallel I/O Module	$2750
9100A-009 Monochrome Video	800
9100A-011 Color Video Card	500
9100A-013 Keyboard	250
9100A-017 Vector Output I/O Module ... Available March, 1989. Contact Factory for pricing.	
910XA/SS Test Station Software Support Agreement	700
9100A/SYS/SS System Software Support Agreement	1800

9105A Options†

9105A-007 512K Memory Expansion	600
9105A-008 Real-time Clock	250

†See option compatibility chart on page 182

Accessories

Y8091 3.5 inch Micro-Floppy Diskettes	85
Y9100A-14D High Quality Dip Clip Module, 14 Pin	185
Y9100A-14S Small Outline Clip Module, 14 Pin	185
Y9100A-16D High Quality Dip Clip Module, 16 Pin	185
Y9100A-16S Small Outline Clip Module, 16 Pin	185
Y9100A-18D High Quality Dip Clip Module, 18 Pin	215
Y9100A-20D High Quality Dip Clip Module, 20 Pin	220
Y9100A-20S Small Outline Clip Module, 20 Pin	215
Y9100A-24D High Quality Dip Clip Module, 24 Pin	230
Y9100A-24S Small Outline Clip Module, 24 Pin	230
Y9100A-28D High Quality Dip Clip Module, 28 Pin	280
Y9100A-28S High Quality Dip Clip Module, 28 Pin	$280
Y9100A-40D High Quality Dip Clip Module, 40 Pin	300
Y9100A-100 Card Edge Fixture Kit	250
Y9100A-101 Card Edge Fixture Base	200
Y9100A-102 Card Edge Interface Module	200
Y9100A-7201 Probe Accessory Kit Contains: One Probe Tip One Probe Tip Cable Assembly One Large Ground Clip Hook One Ground Cable Assembly Eight Small Clock Module Clips	50
Y9100A-DCS DIP Clip Set One Y9100A-14D One Y9100A-16D One Y9100A-18D One Y9100A-20D One Y9100A-24D One Y9100A-28D One Y9100A-40D	1300

Service & Support

Warranty

90-day product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-9100A Repair	360
SC1-9100A/Sys Repair	630
SC1-9100A-003 Repair	150
SC1-9100A-004 Repair	120
SC1-9100A-005 Repair	50
SC1-9100A-009 Repair	100
SC1-9100A-011 Repair	40
SC1-9105A Repair	240

9132A

NEW

9132A

9132A Memory Interface Pod

- Support for 32-bit designs
- Fluke's new HyperTEST™ RAM test algorithm
- Advanced diagnostic capability for isolating bus faults
- Quick memory tests

The 9100A Digital Test System now supports advanced 32-bit designs with the new 9132A Memory Interface Pod. The pod can be adapted quickly and inexpensively to accommodate future microprocessor support needs with only a microprocessor-specific personality module and software disk.

The 9132A connects to the 9100A mainframe in the same way as other Fluke pods to stimulate and test UUT circuitry, but uses a new pod technology. Connection is made through a sync module and by replacing the UUT boot ROMs with ROM modules. The 9132A accesses and controls the UUT's microprocessor through the boot ROM sockets. Instructions are passed through the ROM modules stepping the UUT microprocessor through various built-in and user-written tests. Similar to the user interface for other Fluke pods, the 9132A can be controlled through commands written in high-level language, rather than requiring the user to generate microprocessor-specific assembly code.

Built-In RAM Tests

Thorough testing of the large amounts of memory common to 32-bit designs can take a significant portion of total test time. The 9132 addresses this by incorporating the new high-speed HyperTEST™ RAM test algorithm (patent pending). HyperTEST is immediately executable and can test one megabyte of the UUT's RAM in as little as one second.

Bus Test

In addition to the standard ROM and RAM tests available through the pod's basic WRITE and READ functions, each 9132A processor support package includes a microfloppy containing 9100A programs which provide advanced diagnostic capability in isolating bus faults, and a sync module adapter to help speed up the fault-finding process.

Processors Supported

(for 9100 mainframes)

80386 and 68020. As Fluke develops new microprocessor interfaces, the personality module, database, and microprocessor-specific user's manual will be made available. Check with your Fluke Sales Representative for a current list of processors supported.

ROMs Supported

24 Pin			
2716	2732	2732A	2364A
2366	5366		
28 Pin			
2764	27C64	2364E	23C64E
2365	3864	5365	27128
27C128	23128	23128E	23C128
23C128E	38128	27256	27C256
23256	23C256	53257	27512
27C512	38512	23C1000	531000
32 Pin			
271000			

Ordering Information

Models

January 1989 prices

9132A Memory Interface Pod	$3200
9132A-80386 80386 Processor Support Pkg	1000
9132A-68020 68020 Processor Support Pkg	1000
9132A-024* ROM Module, 24 Pin	800
9132A-028* ROM Module, 28 Pin	800
9132A-032* ROM Module, 32 Pin	800
9132A-100** RAM Module	500

**One needed for each UUT Boot ROM*

***One required for each ROM Module, up to 4 maximum*

Minimum configuration is one 9132A Memory Interface Pod, one Processor Support Package, one ROM Module and one RAM Module. Check with your Fluke Sales Representative to ensure accurate order configuration.

9000 Series

GPIB
IEEE-488

RS-232

9010A Micro-System Troubleshooters

9000 Series Micro-System Troubleshooters

- Preprogrammed kernel test routines
- Simple peripheral troubleshooting
- Keyboard data entry
- 32-digit display
- Power-up self-test
- Keystroke programming (9010A only)
- Language compiler optional (9005A and 9010A)
- Communications interface (RS-232C is optional for 9005A and 9010A; either RS-232 or IEEE 488 is standard for 9020A)
- FREE Troubleshooting Course with purchase!

Special Functions

A. Preprogrammed functional tests, offer structured testing and troubleshooting of the µp's BUS, RAM, ROM and I/O Registers.

B. TROUBLESHOOTING functions: simple READ and WRITE commands allow you to stimulate and observe responses from peripheral interphase adapters (PIAs, CTCs, and UARTs) and circuitry beyond the µP bus. Several special functions are available (RAMP, WALK) with preprogrammed stimulus sequences.

C. Optional RS-232: easy downloading of programs and test results to storage mediums, printers and other testers at remote locations. Optional IEEE-488* for computer controller operation (9020A).

D. TAPE deck controls for storing and reading programs and UUT memory maps on the mini-cassette.

E. LEARN function which is used on a "known good" system, finds and maps RAM, ROM and read/writable I/O addresses.

F. Hexadecimal entry of address descriptors.

G. MODE control of tests and programs.

H. TEST SEQUENCING and ARITHMETIC keys for creating unique user-generated test routines.(9010A only.)

I. PROBE controls used for synchronizing the troubleshooting probe to µP cycles and to drive nodes high and/or low.

J. Pod design provides for safe easy use – Extensive input protection prevents damage to the pod from common accidental abuses such as plugging the pod into the socket backwards. Plug is inserted into socket on pod for self-test. Pins can be protected there when not in use.

Partial List of Processors Supported

Z80A
Z80B
Z8001
Z8002
Z8003
Z8004
1802
1804
1805
1806
6502
6800
68000
68010
6802
6802NS
6808
6809
6809E
8031
8032
8035
8039
8040
8041
8041A
8042
8044
8048
8049
8050
8051
8052
8080
8085A
8085-2
8086
8088
8344
8741
8741A
8742
8744
8748
8749
8751
9900
80186
80188
80286

The 9000 Series Micro-System Troubleshooters – 9005A, 9010A, and 9020A – are among the most comprehensive troubleshooting instruments ever developed for locating faults on microprocessor-based systems. They include built-in preprogrammed test routines for checking the entire microprocessor kernel: bus, RAM, ROM, and I/O. Included is a troubleshooting probe that you can use either to monitor logic action on a node-by-node basis or to inject stimulus pulses.

The three troubleshooters differ primarily in their programming and system capabilities.

The 9010A is a self-contained, programmable model that lets you develop your own customized test programs. Using the 9010A, you can perform specialized guided fault-isolation routines on any portion of a board's digital circuitry.

The nonprogrammable 9005A includes the same built-in tests as the 9010A but cannot generate new test routines. It can, however, run test sequences developed on the 9010A and transferred from a minicassette tape. With the optional RS-232C interface, you can also download test sequences directly from the 9010A or a host computer. Typically, you would develop guided fault-isolation programs at a central location, using a 9010A, and then run the programs at remote sites on 9005As.

The 9020A, designed for systems use, runs test programs written and stored in a system controller or other computer. You can also combine the 9020A with other test instruments to troubleshoot complex microprocessor-based products with special measurement and control problems. The 9020A has no programming keys or cassette tape capability, so test sequences must be executed through the RS-232C or IEEE-488 port.

Read/Write Emulation

The 9000 Series Micro-System Troubleshooters eliminate tedius, manual probing techniques. Instead, they take control of the unit under test by plugging into its microprocessor socket. They then emulate the actions of the microprocessor, both reading data from and writing data to the unit's RAM, ROM, and I/O addresses.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

Built-in Tests

Fluke has taken the trouble out of verifying that the kernel – the heart of the microprocessor system – is operating properly, by including built-in kernel tests in all the 9000 Series Troubleshooters. These tests, initiated by a single keystroke, check the electrical integrity of the microprocessor bus, the read/write capability of the I/O registers, the data in ROM, and RAM operation. A fifth built-in test provides more extensive RAM tests when necessary, checking for pattern-sensitive failures.

The five tests, which cover more than 50% of the components on most boards, check for the problems that are often the most difficult to identify and isolate – including failures that lock up the microprocessor bus. Even if the troubleshooters had no other capabilities, the time saved by these built-in tests alone would more than justify their cost.

Of the five built-in tests, you should run the bus test first, since it verifies the integrity of the microprocessor's basic communication network. To test the remainder of the kernel, you need to enter the address range of RAM, ROM, and I/O for the unit under test, so the troubleshooter will know what addresses to read from and write to. You can enter this information manually through the front-panel keyboard or read it from a minicassette – or, if you have the RS-232C interface, you can download it from a host computer or system controller. If address information is not readily available from the unit's documentation, there is a LEARN algorithm to let you generate a memory map from a known-good board. Once entered, memory-map information can be stored on a minicassette for later use (9005A/9010A).

Beyond the Bus

The 9000 Series Troubleshooters aren't limited to finding kernel-related problems: they can also isolate failures in synchronous circuitry outside the bus. The troubleshooting probe that comes with the 9000 Series will help you track such off-the-bus failures to their source. This probe is a powerful fault-finding tool, useful both for monitoring logic action and for injecting stimulus pulses.

In monitoring, or response mode, the troubleshooting probe takes signatures, counts events, and shows high/low logic states in each node probed. In stimulus mode, it can inject high or low pulses to stimulate readouts, print heads, interfaces, or other devices. Driven by a sync pulse from the interface pod, the probe can be synchronized to various microprocessor events, such as valid address or data periods on the microprocessor bus. You can also choose to use it in "free run" mode, injecting 1 kHz pulses at the contacted nodes.

To further extend the capabilities of the troubleshooting probe, add the asynchronous signature option. This option lets you test asynchronous circuits located outside the microprocessor bus structure (such as DMA controllers, video controllers, and video-generation circuits) without using a logic analyzer or oscilloscope. Tests performed include signature gathering, waveform capture, and event counting. For more information, see the description of the Asynchronous Signature Probe Option.

Custom Test Programming on the Fluke 9010A

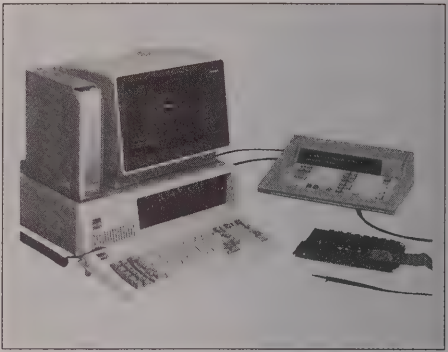
The 9010A lets you write your own comprehensive test routines tailored to the unique characteristics of the equipment you service. These programs can include prompting messages to help guide your technicians through the test procedures. Once written, your test programs can be stored on minicassettes for later use – or for downloading to a 9005A.

You can generate your own test software in two ways. First, you can develop short programs right on the 9010A's keyboard, in much the same way as with a scientific calculator. Second, for more extensive test routines, you can use the 9010A's Language Compiler, developing programs off-line on a personal computer and then downloading them to either a 9010A or 9005A. The Compiler runs on a number of popular personal computers, including the IBM® PC and Kay Pro II® as well as on the Fluke 1720A and 1722A Instrument Controllers. For more information, see the description of the Language Compiler on page 175.

A Powerful Test System Using the Fluke 9020A

The combination of a Fluke 9020A Micro-System Troubleshooter with an IBM or IBM-compatible personal computer and Fluke's TestWriter™ software (see page 176 for more information) gives you a powerful system for performing large-scale guided fault-isolation. In this system, the 9020A is used to stimulate and gather response information from the unit under test; the personal computer acts as both the system controller and the storage medium; and the TestWriter software minimizes programmer time through simplified data-entry procedures.

This test configuration makes developing test programs so easy that it opens the door to new types of tests – tests that previously would have required too much programming time to be cost-effective. And it makes performing the tests so simple that virtually any technician can immediately begin troubleshooting, without going through the extensive training required to use more traditional test techniques.



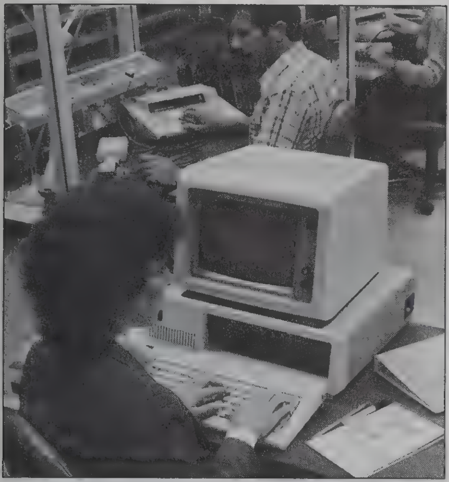
Options and Accessories

9000A-910 Utility Tape

The 9000A-910 Utility Tape contains many programs designed to enhance the operation of the 9010A. These include:

- Merge Tape – Lets you read specific programs from a minicassette tape, renumbering them as desired and merging them with programs already in the 9010A. With this utility, you can combine programs from two or more tapes onto a single tape.
- Frequency Counter – Lets you use the troubleshooting probe to measure frequencies of up to 6 MHz.
- Setup – Lets the 9010A operator make changes in the setup menu while the system is under program control.
- Probe Pulser – Lets the 9010A operator change pulser status while the system is under program control.
- Register Addition and Subtraction – Allows for the addition or subtraction of the contents of two registers while the system is under program control.

The Utility Tape comes with a manual and one minicassette that describes how to use each of these programs.



9010A Language Compiler

If your test routines are short, you can develop them right at the keyboard of the 9010A. For more extensive test routines, you'll find it easier to work off-line on a personal computer, using the 9010A Language Compiler and downloading the results to the 9010A.

The Language Compiler lets you write extensive test and troubleshooting routines more quickly and conveniently. The Compiler is available in several versions, offering compatibility with the following computer systems:

- IBM® Personal Computer (9010A-923)
- Kay Pro® II (9010A-922)
- Fluke 1720A and 1722A Instrument Controllers ((9010A-920)

Sophisticated development tools come with the Compiler to speed the program-development process. Using these features, you can:

- Share common test routines among multiple programs through a File Inclusion feature, linking them together automatically at compile time.
- Save time when entering code by using keyword abbreviations, optional command keywords, and shorthand notations.
- Assign symbolic names to your programs, labels, and registers, making it easier to understand and remember the purpose of the different program sections.
- Document programs with comments imbedded within the program listing, making them easier to follow should you later wish to revise them.

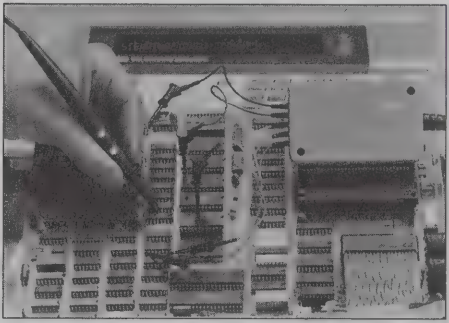
9000A-006 Asynchronous Signature Probe Option

The 9000A-006 Asynchronous Signature Probe Option gives you high-powered fault isolation capabilities for asynchronous circuits located outside the microprocessor bus structure. With this option, you no longer need to augment your 9000 Series Troubleshooter with a logic analyzer.

By adding the Asynchronous Signature Probe to the 9000 Series, you gain the ability to perform real-time measurement of such asynchronous circuits as:

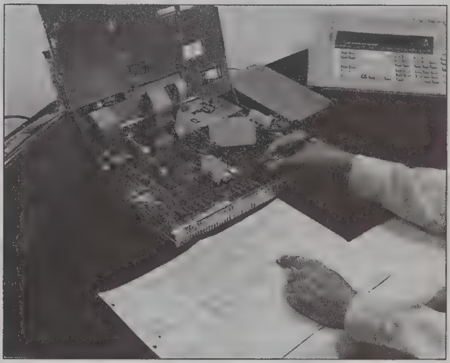
- DMA controllers
- Video controllers
- Video-generation circuits
- Communication circuits
- Peripheral controllers

The Asynchronous Signature Probe provides three distinct troubleshooting measurements:



- Signature gathering, using the cyclic redundancy check technique.
- Waveform capture, in which the probe-tip data stream is sampled every 20 nanoseconds for a total of up to 32 data samples. The results of this sampling are both displayed and stored.
- Event counting, a powerful tool for node characterization. Using this feature, you can count events from the probe tip, either continuously or through a measurement window. A 24 bit register allows you to record over 16 million events.

The Asynchronous Signature Probe consists of a circuit board, installed in the 9000 Series mainframe; a clock module, which picks up timing and control signals from the unit under test; and a special set of operating programs contained on a minicassette tape.



FREE Training Certificate Program

When you purchase any of the 9000 Series models, you will receive, upon request, a special certifcate entitling you to the 9010 Board Tester Troubleshooting course. You will enhance your troubleshooting proficiency and become productive even faster with this program.

9020A-925 TestWriter

Fluke's TestWriter software, combined with the 9020A Micro-System Troubleshooter, an interface pod, and an IBM (or IBM-compatible) personal computer, makes it easy to develop guided fault-isolation or automated diagnostic programs for digital circuit testing. In this configuration, the personal computer, communicating with the 9020A-001 through its RS-232C interface, acts as both a system controller and a storage medium.

TestWriter offers the best of both worlds in regards to program generation and execution. Programmers will welcome TestWriter's time-savings and simplified data entry procedures. Operators will appreciate the use of menus in directing the testing process, as well as the easy-to-read graphic feedback of the testing process.

TestWriter's ability to automatically generate a fault tree eliminates the tedious time-consuming process of entering individual decision statements when structuring a program. The programmer simply enters UUT descriptive information: the component types and their interconnectivity. This time-saving feature, together with the increased memory capacity in the PC is what makes TestWriter extremely effective when generating large GFI programs.

The test engineer proceeds by developing a set of stimulus routines; one and, sometimes, several for each node on the UUT.

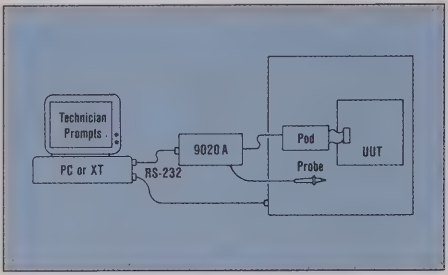
The last step in completing the GFI program is to gather responses on each node of a "known good" UUT while stimulated by the corresponding stimulus routine(s). These responses are stored in a separate file which will be used for comparison with responses from a defective board during the fault isolation process.

TestWriter also simplifies the process of troubleshooting defective units. The operator makes selections from menus, aided by prompts and graphic displays. The personal computer automatically sends the appropriate commands to the 9020A and records the responses. It also provides a graphic display of the node that the operator is probing, along with the other points that drive that node.

As each nodal measurement is taken, the display will show whether the response was GOOD or BAD. The software will continue to ask for probe points until it can make a decision on the cause of the problem. Once made, this decision is displayed on the CRT.

For cases where the operator is experienced in troubleshooting a particular board, TestWriter also allows unguided fault isolation, in which the operator decides the order in which nodes are to be tested.

Test Station Configuration

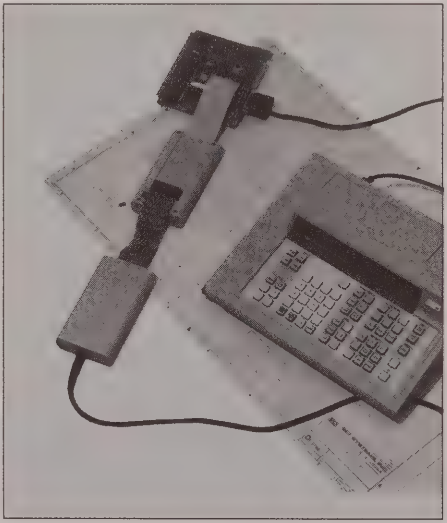


9010A/GF Upgrade Kit

This kit, in conjunction with the 9010A-001 (RS-232C interface port), transforms a 9010A into a dual purpose unit: it will continue to function as a standard 9010A and, in addition, can function as a 9020A-001. As a 9020A, this unit can operate with the above described TestWriter software, which executes on an MS-DOS compatible personal computer.

This upgrade kit allows you to execute all existing test procedures on the 9010A and expands its utility by offering you the ability to interface it with a pc and utilizing the power of the TestWriter software system.

The upgrade may be ordered as a kit for Fluke field service center installation in your unit or can be ordered factory installed for new units. The installation adds an internal module and a switch labeled GFI (Guided Fault Isolation) on the rear panel. In the GFI-ON mode the 9010A with 9010A/GF option behaves as a 9020A.



Transit Cases

Lockable hard case holds 9000 Series pod, probe, accessories, four mini-cassette tapes, and user's manual. Foam-lined, sturdy construction.

Specifications

Technical Specifications

Display: Vacuum fluorescent; displays up to thirty-two 14-segment alphanumeric characters at once.

Self Test: All 9000 Series units perform self-tests at each power-up, verifying proper operation of internal RAM, ROM, clock, power supply, display, and communications with interface pod. Pod has own self-test socket to verify proper operation at microprocessor plug.

Test Speed: Tests run at full system speed, based on clock in unit under test.

Keyboard Data Entry: Hexadecimal 0 through 9 and A through F.

Mag Tape: (9005A and 9010A only). Minicassette tapes store all "learned" data plus test programs generated on-line for off-the-bus testing. One tape holds up to 12K bytes – the same as internal memory on the 9005A and 9010A. Both units come with a built-in tape drive.

Interface Pod: Plugs into 9000 Series mainframe; must match type of microprocessor used in circuits being tested. Pods available for 8-bit and 16-bit microprocessors. Special circuitry protects pods from damage even if plugged in backwards.

Troubleshooting Probe: Plugs into 9000 Series mainframe. In response mode, takes signatures, counts events, shows logic states; in stimulus mode, injects either clock-synchronized or 1 kHz pulses. Measurement thresholds are 0.8V (low), 2.4V (high). Stimulus pulses are <0.2V at 100 mA (low), >4V at 100 mA (high). Probe is protected to ±30V.

Automatic Functions Summary

Learn Mode: (9010A and 9020A only). Uses a known-good system of same type as unit under test to locate and determine size of RAM, ROM, and read/writeable I/O registers, and to compute signatures. Stores results in memory for immediate comparison to circuits being tested; data can also be saved on minicassette or (with RS-232C option) downloaded to another system or device.

Built-In Kernel Tests: Using data entered either automatically through Learn mode or manually through the keyboard, the 9000 Series Troubleshooters can perform the following tests of kernel circuitry (each initiated by a single keystroke):

- BUS – Checks electrical integrity of address, data, and control lines; isolates stuck nodes and adjacent-trace shorts.
- RAM SHORT – Checks each RAM location for ability to read and write; verifies address decoding; detects data-line shorts beyond bus buffers.
- ROM – Computes ROM signatures and compares them with those in the known-good unit.
- I/O – Checks each I/O register identified in the known-good system to make sure it is read/writeable.
- AUTO – Runs all the above tests; initiated by a single keystroke. (Typically requires several minutes, depending on size of memory being checked.)
- RAM LONG – A more complex RAM test, used to isolate "soft" or pattern-sensitive RAM faults.

In addition, 9000 Series Troubleshooters continually monitor the power supply of the unit under test for out-of-tolerance conditions as well as the UUT clock signal. An error message is displayed if they detect a defect.

Troubleshooting Functions Summary

The following function keys are available on the 9000 Series Micro-System Troubleshooters:

- READ – Displays data contents of specified address.
- WRITE – Writes specified data to any address location.
- WALK – Writes automatic walking pattern to specified address.
- RAMP – Writes automatic binary incrementing ramp to specified location.
- TOGGL DATA – Pulses specified data bit between high and low state.
- TOGGL ADDR – Pulses specified address bit between high and low state.
- TOGGL DATA, then STS/CTL – Pulses specified control bit between high and low state.
- READ PROBE – Displays probe measurements, including signatures, logic states and event counts.
- SYN – Allows probe measurements or stimulus to be either asynchronous or synched to valid address or data periods on the microprocessor bus.
- HIGH (Pulse) – Activates high-going pulses. The frequency and width of the pulses depend on the sync mode selected.
- LOW (Pulse) – Activates low-going pulses. The frequency and width of the pulses depend on the sync mode selected.
- HIGH and LOW toggle – Pulses alternate between high-going and low-going.

Also, a scope trigger-signal of about 100 mV amplitude can be synchronized with address or data sync pulses from the mainframe.

Test-programming Functions Summary (9010A)

(Not applicable to 9020A: available in execute-only mode on 9005A.) Users wishing to troubleshoot beyond the system kernel into peripheral devices can write and edit test programs tailored to the unique architecture of the systems they work with. The following keys are available for on-line programming:

- PROGM – Opens and closes test programs (both for development and for editing).
- EXEC – Runs selected test program.
- DISPL – Allows programs to include operator prompts (e.g., PROBE U6 PIN 7).
- Sequencing keys (IF, > =, GOTO, LABEL) Available for comparison, branching, looping, and labeling steps in the test program.
- Arithmetic keys – Eight logical operations available for arithmetic control of mainframe registers that store user-specified address and data information during program writing.
- Editing keys – Allow the operator to scroll backwards or forwards through the programming steps.

Mode Control Summary

Mode control keys give operator control over all functions: automatic tests, programmed tests, and troubleshooting operations. The following mode control keys are available:

- STOP – Halts current test or operation.
- RPEAT – Causes test or operation to repeat once.
- CONT – Advances to next test step or continues last operation.
- LOOP – Continuously repeats a functional test, programmed test step, or troubleshooting command or loops on any fault.
- RUN UUT – Allows full exercise of both the self-diagnostics and normal run operation of the unit under test, with the pod microprocessor acting as the processor of the unit being tested.

General Specifications

Temperature: 0°C to +50°C operating temperature (+10°C to +40°C for minicassette); -40°C to +70°C non-operating temperature (+4°C to +50°C for minicassette)

Power: 100, 120, 220, 240V ac ±10%; 50 Hz, 60 Hz ±5%; 40W maximum

Size: 11.5 cm H x 35.5 cm W x 30.5 cm D (4.5 in H x 14 in W x 12 in D)

Weight: 6 kg (13 lb) mainframe; 0.7 kg (1.5 lb) per interface pod

Included: Probe, probe accessories, two minicassettes (none with 9020A), manuals, power cord

Ordering Information

Models	January 1989 prices
9005A Micro-System Troubleshooter	$3190
9010A Micro-System Troubleshooter w/Program Functions	5290
9020A-001 Micro-System Troubleshooter w/RS-232-C Interface	5590
9020A-002 Micro-System Troubleshooter w/IEEE-488 Interface	5590

Options† (For 9010A & 9005A)

-001* RS-232-C Interface	450
-910 Utility Tape	95
-920 Language Compiler compatible w/Fluke 1720A & 1722A Instrument Controllers	495
-922 Language Compiler for Kay Pro® II	495
-923 Language Compiler for IBM Personal Computer	495
9010A/GF* Kit (field-installed)	495
9010A/GF Kit (factory-ordered)	495

Options (For 9010A, 9005A & 9000A)

-006* Asynchronous Signature Probe	995

Options (For 9020A and 9010A/GF)

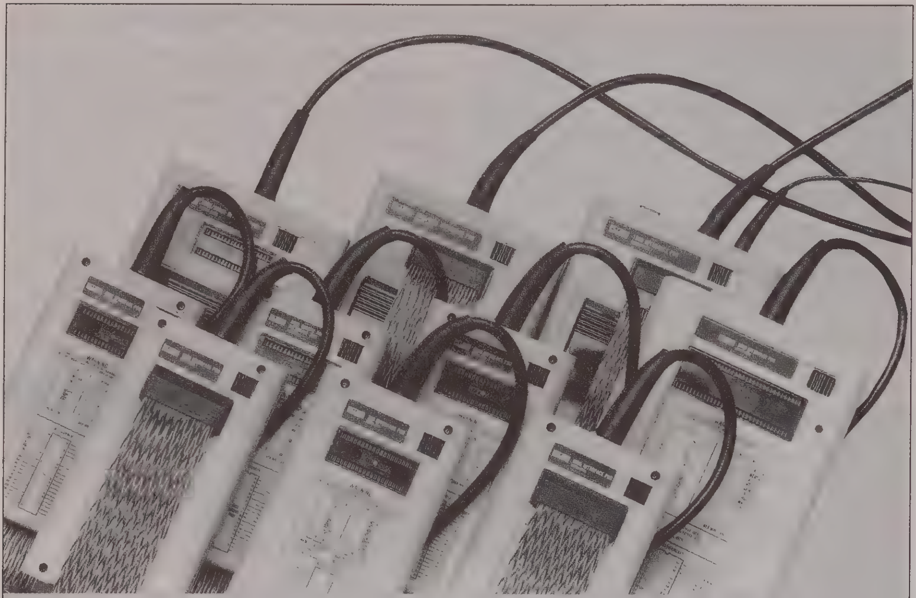
-925 TestWriter Software	1500

Accessories

9000A-200 Pod Adapter Packaging Kit	195
9000A-900 Transit Case	295
Y8007 Ten-Pack of Mini-cassettes	150

**Service Center installable only. Other user-installable.*
†See option compatibility chart on page 182

9000 Series Interface Pods



Micro-System Troubleshooters Interface Pods

Interface Pods

- 50 microprocessors supported
- Adapter kits available for other microprocessors
- Easy connection to unit under test
- Intelligent pods with built-in software*
- Quick memory tests*
- Quick looping Reads and Writes*
- Built-in self-diagnostics

**Available on some pod models only. See Table 1 for a listing of pods offering these features.*

How the Interface Pod Works

The interface pod functions as the test interface between the suspect circuit board and the troubleshooter mainframe, adapting the general architecture of the mainframe to that of the specific microprocessor system under test. When you plug the pod into the unit under test, you are effectively replacing the microprocessor in that unit with the micro-processor in the pod.

This unique test connection gives the Fluke troubleshooter mainframe the ability to access board and system components directly, through the central control element of the entire system – the microprocessor. As a result, you get exceptionally high-confidence test results.

Unlike emulators and development systems intended for software debugging, these interface pods are designed specifically for hardware troubleshooting. Each pod is a self-contained system with its own microprocessor, RAM, ROM, and I/O memory space. This means that the unit being tested does not need to be operating for the Fluke troubleshooter to begin testing. It also means that you can test for multiple faults by simply disabling each faulty line as it is identified and continuing to run the tests.

Each pod includes a RUN UUT function to let you test the unit's operation as though it were operating under its own microprocessor. When this function is activated, it electrically disconnects the unit being tested from the tester, letting it perform as if its microprocessor were still in the socket.

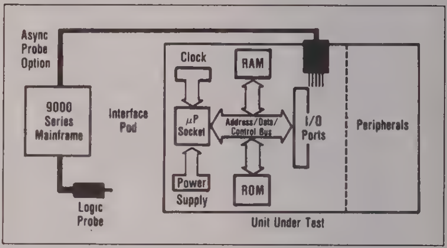
Microprocessors Supported

Fluke interface pods currently support an extensive range of microprocessors, as shown in Table 1. New pods are added regularly to support additional microprocessors as they are introduced.

IBM is a registered trademark of International Business Machines Corporation.

Kay Pro II is a registered trademark of Non-Linear Systems, Inc.

The interface pod obtains its clock signal from the unit under test and runs at the same speed as the unit. Since manufacturers often build a particular microprocessor in different versions, each running at a different clock speed, Fluke selects the fastest clock speed available when designing its pods. This ensures the pod's ability to test any processor in that family, regardless of clock speed.



Advanced Pod Features

As microprocessor technology advances, Fluke has made its pods correspondingly larger and more powerful. Accordingly, the newer pods (indicated by an * in Table 1) offer advanced features not available in some of the earlier models. These include more intelligence, interrupt features, quick memory tests, and quick looping read and write tests.

Table 1. Microprocessors Supported by Fluke Interface Pods

System μP	Pod Model #	System μP	Pod Model #
Z80A	9000A-Z80	8041A	9000A-8048*
Z80B	9000A-Z80/AA	8042	9000A-8048*
Z8001	9000A-Z8000*	8044	9000A-8051*
Z8002	9000A-Z8000*	8048	9000A-8048*
Z8003	9000A-Z8000*	8049	9000A-8048*
Z8004	9000A-Z8000*	8050	9000A-8048*
1802	9000A-1802*	8051	9000A-8051*
1804	9000A-1802*	8052	9000A-8051*
1805	9000A-1802*	8080	9000A-8080
1806	9000A-1802*	8085A	9000A-8085
6502	9000A-6502	8085A-2	9000A-8085
6800	9000A-6800	8086	9000A-8086*
68000	9000A-68000*	8086	9000A-8088*
68010	9000A-68000*	8344	9000A-8051*
6802	9000A-6802	8741	9000A-8048*
6802NS	9000A-6802	8741A	9000A-8048*
6808	9000A-6802	8742	9000A-8048*
6809	9000A-6809	8744	9000A-8051*
6809E	9000A-6809	8748	9000A-8048*
8031	9000A-8051*	8749	9000A-8048*
8032	9000A-8051*	8751	9000A-8051*
8035	9000A-8048*	80186	9000A-80186*
8039	9000A-8048*	80188	9000A-80188*
8040	9000A-8048*	80286	9000A-80286H*
8041	9000A-8048*	9900	9000A-9900

** Incorporates one or more advanced features (see discussion under "Advanced Pod Features" in this section.)*

Note: For microprocessors not found in this table, contact your local area Fluke Sales Office or Representative for a copy of Technical Data B0156, "User-Designed Interface Pod Adapters."

9000 Series Interface Pods

More Intelligence. Many of the newer pods feature additional built-in software, enhancing the troubleshooting and test capabilities of the mainframe. With this software, the user need only send the test parameters to the pod from the troubleshooter mainframe. The pod will independently execute the specified function, providing much faster test results than is possible with mainframe execution.

Interrupt Features. Some of the newer pods also have interrupt testing capabilities, allowing them to read information from received interrupts. The user can control the configuration of the pod's interrupt lines, enabling and disabling interrupts and forcing interrupt-acknowledge cycles.

Quick Memory Tests. Fluke has increased the speed of memory testing in many of its newer pods, including the 8051, 8086, 8088, Z8000, 68000, 80186, 80188, and 80286 building Quick RAM and Quick ROM tests into the pod software. In addition to greatly reducing the test time, these tests provide:

- A choice of byte or word test for the 16-bit microprocessors
- A choice of address increment size
- More flexibility under program control

The Quick RAM test consists of two parts. The first rapidly tests the read/write capabilities of either small segments of memory or the entire block of RAM. The second, a pattern verification test, verifies that memory addresses are being properly decoded and checks dynamic RAM memory for refresh problems, verifying its ability to retain accurate information.

The Quick ROM test uses a checksum procedure to test the ROM for faults. It also finds any inactive data bits (bits that always read high or low regardless of the ROM address selected).

Quick Looping Read or Write. The Quick Looping Read or Write function rapidly performs continuous Reads or Writes at a specified address. This feature lets you easily view bus signals on an oscilloscope synchronized to the TRIGGER OUTPUT pulse (located on the rear panel of the Troubleshooter). By increasing the repetition rate of the oscilloscope trace, this function makes the trace signal brighter and therefore easier to see.

HyperTEST™ RAM Test Algorithm

Thorough testing of the large amount of memory commonly available with the newer 16-bit processors can take a significant portion of the total test time. The 9000-80286H pod addresses this by incorporating Fluke's new high-speed HyperTEST™ RAM Test Algorithm (patent pending). HyperRAM can be executed in immediate mode as well as under program control. It can test one megabyte of the UUT's RAM in as little as one second.

Special Circuitry

Because the pod is intended to be used with defective micro-systems, Fluke designed it with special input protection circuitry. This circuitry provides overvoltage protection on each line to the unit under test – even if the pod is plugged in backwards. Other pod circuitry monitors and checks each read/write operation as it is performed. A self-test socket is included for verifying proper pod function.

Pod Adapter Packaging Kit

Allows testing of many microprocessor systems not directly supported by a Fluke interface pod. Consists of all the parts necessary to house the adapter circuitry, to connect the pod to the adapter, and to connect the adapter to the UUT.

Ordering Information

Interface Pods

January 1989 prices

9000A-Z80	$1190
9000A-Z80/AA	1390
9000A-Z8000*	2090
9000A-1802*	1690
9000A-6502	1190
9000A-6800	1190
9000A-6802*	1190
9000A-6809*	1590
9000A-8048*	2090
9000A-8051*	2090
9000A-8080	1190
9000A-8085	1190
9000A-8086	2590
9000A-8088	2590
9000A-9900	2090
9000A-68000*	2590
9000A-80186	3090
9000A-80188	3090
9000A-80286H	3590

**Each of these pods supports a family of microprocessors.*

Accessories

9000A-200 Pod Adapter Packaging Kit	195
9000A-201 8051 Clip-on Adapter	95
Y9000A-80286-7202 PLCC Clip-on Adapter	395

Service & Support

Warranty

One year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty*

SC1-9000A-Z80 Repair	151

**Extended Warranty available on other pods also.*

90 Series

90 Series

90 Series µP Board Tester

- QuickTrace™ to automatically test, identify and follow the microprocessor's address, data and control lines
- A logic probe for isolating faults at nodes not directly connected to the microprocessor
- Bus Tests to determine if any bus line is stuck high or low or shorted to other bus lines
- Memory Tests to determine if RAM can be properly written and read, and if ROM contains the proper bit patterns
- I/O Tests to determine if I/O addresses can be written and read
- The detection and trapping of selected events with the Break-Point, Frame-Point, and External Trigger functions, as well as Memory Upload and Download

The Fluke 90 Series is a family of compact, powerful, inexpensive testers for isolating and diagnosing faults in microprocessor-based products and systems. The 90 Series is completely self-contained and clips directly onto the microprocessor in the Unit Under Test (UUT). This clip-on reduces test setup times, and allows systems with soldered-in microprocessors to be tested and serviced.

Pre-Programmed Tests

The 90 Series is pre-programmed with a battery of tests that find UUT problems quickly. These tests are selected from easy to understand menus, virtually eliminating training time. Starting at the UUT's kernel and working through the busses to memory and peripheral devices, these tests allow the operator to quickly isolate system faults. 90 Series tests are divided into four basic groups:

Bus Tests

Isolate bus lines stuck high or low, or bus lines shorted to other bus lines.

Memory Tests

Test system RAM and ROM. These tests do not interrupt UUT operation. Other tests examine and modify memory contents, or exercise memory mapped peripherals while the UUT is operating.

I/O Tests

Examine and modify the contents at I/O addresses or exercise peripherals while the UUT is operating.

Probe Tests

Isolates shorted or stuck address, data and control lines. Quick Trace™ automatically identifies bus lines and allows them to be tracked through the UUT.

QuickTrace™

```
QuickTrace
 A10  A15
```

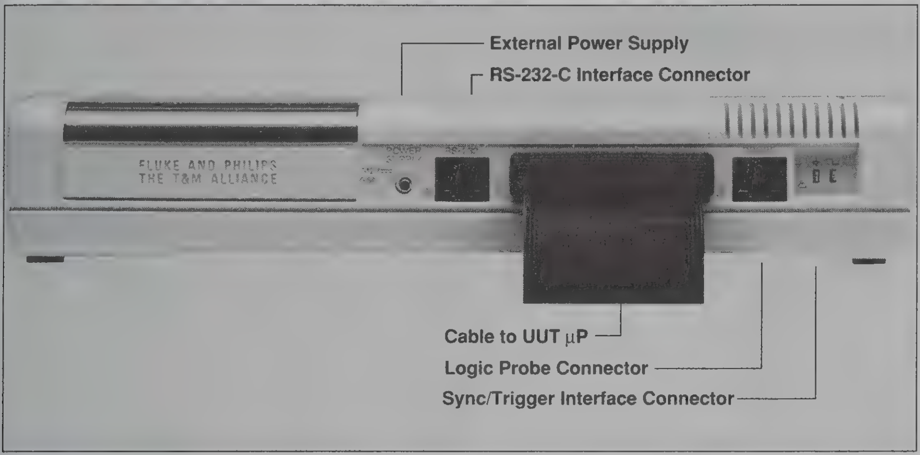
Shorted or stuck bus lines can be the most difficult faults to find. The 90 Series offers several tests to help isolate those faults. One of the most powerful is QuickTrace.™ Using the logic probe, circuit nodes are automatically identified. When recognized, the circuit node's name is displayed, and the probe light changes from red to green. In addition to immediate identification, any address, data, or control lines shorted together are also reported.

Real Time Testing

While performing most tests, the 90 Series "cycle steals" and drives the UUT's address, data, and control busses. This unique and proprietary technique allows testing, without disrupting normal UUT operation. The UUT continues to run at full system speed and execute its normal operations. This "cycle stealing" technique allows memory or I/O address to be tested, examined or written to without disturbing UUT operation. Marginal components and intermittent failures can be easily isolated. The UUT can be mechanically or thermally stressed while performing normal operations at the same time the 90 Series is testing. Voltage sensitive components can be also isolated by testing while the UUT power supply voltage is varied.

Testing External Devices

The 90 Series comes with a logic probe and SYNC/Trigger interface to aid in diagnosing problems in circuits outside the UUT's bus and memory. This SYNC/Trigger interface enhances oscilloscopes for troubleshooting digital problems by synchronizing it to valid UUT bus states. Only stable bus states are recognized, eliminating "garbage" due to triggering during non-valid bus conditions. When no tests are being executed, both the logic probe and external trigger are synchronized to the "data valid" state of the UUT's bus. When the 90 Series is performing a test, both the probe and External SYNC/Trigger interface are synchronized to the test performed by the 90 Series, allowing more detailed examination of the forced event.



Advanced Troubleshooting Support

The 90 Series also has an RS-232 interface for remote operation and control. When operated remotely, all commands and operations available at the front panel are available via the RS-232 interface. Predefined tests sequences for automated fault isolation can be implemented. Additional diagnostic features are also present.

Breakpoint, Framepoint, and External Trigger

The 90 Series can be configured over the remote interface to execute a trap on preselected UUT events. Unusual or infrequent events are easily isolated for added fault finding power.

These traps trigger whenever the selected UUT event (memory examine, memory write, I/O examine, I/O write, interrupt acknowledge; or op-code fetch) occurs. They can be qualified by requiring a specified address or data bus value, and/or by requiring the probe to be in a given state. These traps can be used to; 1) Halt the UUT's microprocessor (Breakpoint) and display address and data information; 2) take a snapshot of the address and data busses (Framepoint) allowing the UUT to continue to run or; 3) generate a pulse at the SYNC/Trigger inteface (External Trigger).

Memory Upload and Download

The contents of UUT ROM and RAM can be uploaded and RAM contents can be downloaded via the remote interface. ROM contents can be uploaded and reverse assembled to produce software listings that might not otherwise be available.

QuickTools™ Software

QuickTools™ software makes remote operation of the Fluke 90 Series as easy as using the tester's front panel, and allows for interaction with the 90 Series' remote functions. QuickTools software provides an easy means of establishing remote control of the 90 Series with an IBM PC® or compatible to save, edit, and execute a series of test commands and to store and print the test results.

Ease of programming and operation are supported by menus, help screens and single keystroke command prompting. The software helps perform user-definable actions such as branches, calls and pauses within a test procedure. QuickTools software also allows for online operator instructions and messages. These can be combined with preprogrammed functions such as probe and QuickTrace applications.

In addition, test actions can be taken on the remote "breakpoint" and "framepoint" functions, permitting detailed monitoring and analysis of both field equipment and installed systems.

QuickTools software also supports the uploading and downloading of memory in Intel and Motorola hex format, and you can enable the external trigger for various applications. The RS-232 cable, provided with the unit, offers quick system connection.

Specifications

Microprocessors Supported: 8085, 6809E, 6809, Z80
Functions Supported: Power Supply Test; Clock Test; Control Line Test
Bus Tests: Shorted Address, Data or Control Lines; Stuck Address, Data or Control Lines
Ramp Test
Shift Test
Memory Tests: Test Memory; Checksum Memory; Examine Memory; Verify Memory; Write Memory; Memory Soak Test
I/O Tests: Examine I/O Port; I/O Verify Test; Write I/O Port
RS-232 Port Configuration Command
Probe Tests: QuickTrace™; Probe Address Lines; Probe Data Lines; Probe Control Lines
Break-Point, Frame-Point and External Trigger Commands: General Address Qualifiers; General Data Qualifiers; General Probe State Qualifiers; General Loop Count Qualifiers; CPU Function Qualifiers; Memory Read/Write CPU Function Qualifiers; I/O Read/Write CPU Function Qualifiers; Opcode Fetch CPU Function Qualifier; Interrupt Acknowledge CPU Function Qualifier
Memory Fill Command
Up-Load Memory Command
Down-Load Memory Command
RS-232-C Interface: Interconnect cable with DB-25 socket connector included. Uses XON/XOFF Protocol

Operating Conditions

Timing: Up to 20 MHz
Voltage: From UUT: 4.8 VDC to 5.3 VDC: Ext. PS: (7 VDC to 12 VDC)
Power Consumption: Less than .75W
Relative Humidity: Up to 80% 0°C to 35°C; up to 70% 35°C to 50°C, non-condensing
Ambient Temperature: 0°C to 50°C
User Interface: A 2-line by 16-character LCD panel. 24-key keypad: 16-keys for hex digit entry; 8-function-specific keys
Size: 280 mm W x 152 mm D x 51 mm H (11 in W x 6 in D x 2 in H)
Weight: 1.0 kg (2 lb 3 oz)
Includes: User's manual, probe, RS-232 cable, application notes, 17-min video showing how to use Fluke 90

Ordering Information

Models	January 1989 prices
Fluke 90 Z80 µP Board Tester	$1595
Fluke 90 8085 µP Board Tester	1595
Fluke 90 6809/6809E µP Board Tester .	1595
Fluke 90 S100 QuickTools Software	300

Option Compatibility

9005A, 9010A, 9020A Option Compatibility

Option	Description	9005A	9010A	9020A-001	9020A-002
9000A-*	Interface Pods (all)	•	•	•	•
9010A-001	RS-232 Interface	1	1	#	–
9000A-006	Asynchronous Signature Probe	1	1	1	1
9000A-010	Demonstration and Training Package	2	2	2	2
9000A-200	Kit for customizing Interface Pods	3	3	3	3
9000A-201	Clip-on Adapter for -8051 Pod	•	•	•	•
9000A-900	Transit Case	•	•	•	•
9000A-901/AC	PCB for Troubleshooting Classes	•	•	•	•
9000A-910	Utility Tape	–	•	–	–
9010A-920	Language Compiler for 1722A or 1720A	–	4	–	–
9010A-922	Language Compiler for Kay Pro	–	5	–	–
9010A-923	Language Compiler for IBM PC	–	5	–	–
9020A-925	Testwriter, PC Software	6	6	7	–
9000A-9711	Tape for Troubleshooting 8520As	•	•	–	–
9010A/GF	For Guided Fault Testing w/Option -925	1	1	–	–
Other Items					
Y8007	Package of Ten Minicassette Tapes	•	•	–	–

Notes: All options are customer-installable except where noted.

† *Compatible option*

* *Option suffix identifies Interface Pod type*

RS-232 capability included

1 *Installed at Factory or, at extra charge later, order through Service Center*

2 *Requires 9000A-80286 Pod*

3 *Use only on 40-pin microprocessor adaptations*

4 *Option 9010A-001 is required. E Disk Option 1720A-001 is required for 1720A*

5 *Option 9010A-001 is required*

6 *Requires IBM PC with RS-232 Interface, 9010A, and 9010A/GF*

7 *Requires IBM PC with RS-232 Interface*

9100 Series Option Compatibility

Option	Description	9100A;/SYS	9100A	9105A
9000A-*	Interface Pods (all)	•	•	•
9100A-003	Parallel I/O Module (four can be used)	#	•	•
9100A-004	Programmers' Station w/Monochrome Monitor	#	1	–
9100A-005	Programmers' Station w/o Monitor (for Color)	–	1	–
9105A-007	512K Memory Expansion	–	–	1
9105A-008	Real-Time Clock	–	–	1
9100A-009	Monochrome Monitor	2	1	1
9000A-010	Demonstration and Training Package	4	4	4
9100A-011	Color Video Card	–	1	1
9100A-012	2 M-Byte Memory Expansion	1	1	–
9100A-013	Keyboard	#	•	•
Other Items				
Y8091	Package of Ten 3.5-inch Floppy Disks	#	#	#
Y9100A-DCS	DIP CLIP Set (-14D through -40D)	#	•	•

Notes: All options are customer-installable except where noted.

† *Compatible option*

* *Option suffix identifies Interface Pod type*

# *One included*

1 *Installed at Factory or, at extra charge later, order through Service Center*

2 *Included as part of 9100A-004*

Calibration Instruments

Page 187 5700A

Page 187 5725A

FLUKE 742A-1 RESISTANCE STANDARD
CURRENT SENSE
FLUKE 742A-10k RESISTANCE STANDARD
CURRENT SENSE
CHASSIS GROUND

Page 228 742A-1 & 742A-10k

Page 229 732A

Page 218 7457A

Page 193 5100B

All electrical and electronic test and measurement instruments must be calibrated – when they are manufactured, and at regular intervals, to ensure accuracy and confidence in their measurements. Practically all instruments that measure voltage, current or resistance, can be calibrated with Fluke calibrators, standards, and auxiliary equipment.

Fluke is the leader in calibration equipment. This leadership applies to advancement in precision equipment and software and support services that greatly improves the productivity of calibration professionals. If you think it may be economical to calibrate your own voltmeters, ammeters, ohmmeters, multimeters, oscilloscopes, or other instruments of that kind, study Fluke's complete calibration-solutions on the following pages.

Selection Charts 184
Calibration Instruments 187
Calibration Systems and Software 212
Standards Instruments 227

What is Calibration?

Calibration is a special, highly-refined process in which you compare an instruments performance with standards of known uncertainty to detect or correct any variation from required performance. In other words, it is a process verifying the operational integrity of instruments.

All electrical and electronic test and measurement instruments must be calibrated, both at the time of manufacture and at regular intervals during use, to assure the accuracy of and confidence in the measurements you make. You will also find that in many instances certification of calibration is a legal requirement.

Calibration provides two major benefits. First, it allows you to use your instruments with confidence by minimizing the uncertainties associated with your measurements. Second, it fulfills the requirements for "traceability" to national standards demanded so frequently today.

Fluke is the leader in DC and low frequency calibration. Fluke provides a broad range of products, from calibration instrumens, to automated calibration systems, and the standards required to maintain them. If you calibrate voltmeters, ohmmeters, ammeters, multimeters, oscilloscopes, or other electronic test and measurement instruments, Fluke has the calibration solutions to match your workload.

The range of Fluke products includes high-accuracy single-function calibrators for calibrating your high end voltmeters. Fluke also provides multifunction manual and bus-controllable calibrators that can economically calibrate the bulk of your low- and mid-accuracy workload. These include a full line of accessories and auxiliary products.

Fluke also offers the next logical step in calibration, automated systems that will increase your productivity and repeatability, while easing your documentation process. You can start the automation process without replacing your existing instrument inventory. Instruments you purchase now can be integrated into systems as your workload expands. And what you need to add later will work with what you have now. Fluke provides the calibration software to meet your calibration workload.

Fluke's commitment to the calibration market includes the support services you require. Applications support, training, traceability programs, maintenance, repair, calibration services, and module exchange programs you expect are all available from Fluke.

Study the Fluke calibration solutions on the following pages. If you need assistance, contact your Fluke Account Manager or call Fluke (toll free in the U.S.) at 800-426-0361.

Automated Calibration Systems Based on 7411 Calibration Software

Model	Oscilloscope Calibration	Multimeter Calibration	Measurement Capability	Page
7457A	—	Yes	—	220
7451A	—	Yes	Yes	222
7409B	Yes	—	Yes	224
A123	Yes	Yes	Yes	226

AC/DC Transfer Standards

Model	Volts	Current	AC/DC Difference	Frequency Range	Page
540B	To 1000V	With A40 A40A	0.01%	5 Hz to 1 MHz	234
A55	0.5	–	0.05% to 0.5%	1 MHz to 50 MHz	236
A40	–	10 mA to 5A	0.02% with 540B	5 Hz to 100 kHz	235
A40A	–	10 A to 20A	0.03% with 540B	5 Hz to 50 kHz	235

Calibrators

Model	Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Resistance	Wideband Voltage	Basic Uncertainty	IEEE-488	Page
5700A	To 1100V	To 1100V	To 2.2A	To 2.2A	1.0Ω to 100 MΩ	Option	5 ppm	Yes	187
5100B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	40 ppm	Option	193
5101B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	50 ppm	Option	193
5440B	To 1100V	–	–	–	–	–	3 ppm	Yes	197
5442A	To 1100V	–	–	–	–	–	4 ppm	Yes	197
5200A	–	To 120V	–	–	–	–	200 ppm	Option	199
5450A	–	–	–	–	1.0Ω to 100 MΩ	–	8 ppm	Yes	202
335A	To 1110V	–	–	–	–	–	20 ppm	No	208
335D	To 1110V	–	–	–	–	–	10 ppm	No	208
343A	To 1110V	–	–	–	–	–	20 ppm	No	209
515A	To 100V	To 100V	–	–	10Ω to 100 MΩ	–	30 ppm	No	210

Amplifiers

Model	Output Range	Compatible Calibrator	Gain Transcond.	Page
5725A	1100V 1 to 11A AC/DC	5700A	–	187
5205A	1200V rms 1600V dc	5100B 5101B 5102B 5200A 5440B	100	203
5215A	1200V rms	5100B 5101B 5102B 5200A	100	205
5220A	1 to 20A	5100B 5101B 5102B 5440B	1A/V	207

Reference Standards

Model	Amplitude Stability	Direct Voltage	Alternating Voltage	Resistance	Frequencies	DVMP*	Page
510A	±0.005 % in 30 Days	–	10V rms	–	50 Hz to 100 kHz	No	237
731B	10 ppm	10V 1V 1.018V ΔV	–	–	–	No	238
732A	0.5 ppm	10V 1V 1.018V	–	–	–	Yes	229
742A	5 ppm	–	–	1Ω and 10 kΩ	–	–	228

**Direct Voltage Maintenance Program. See page 231.*

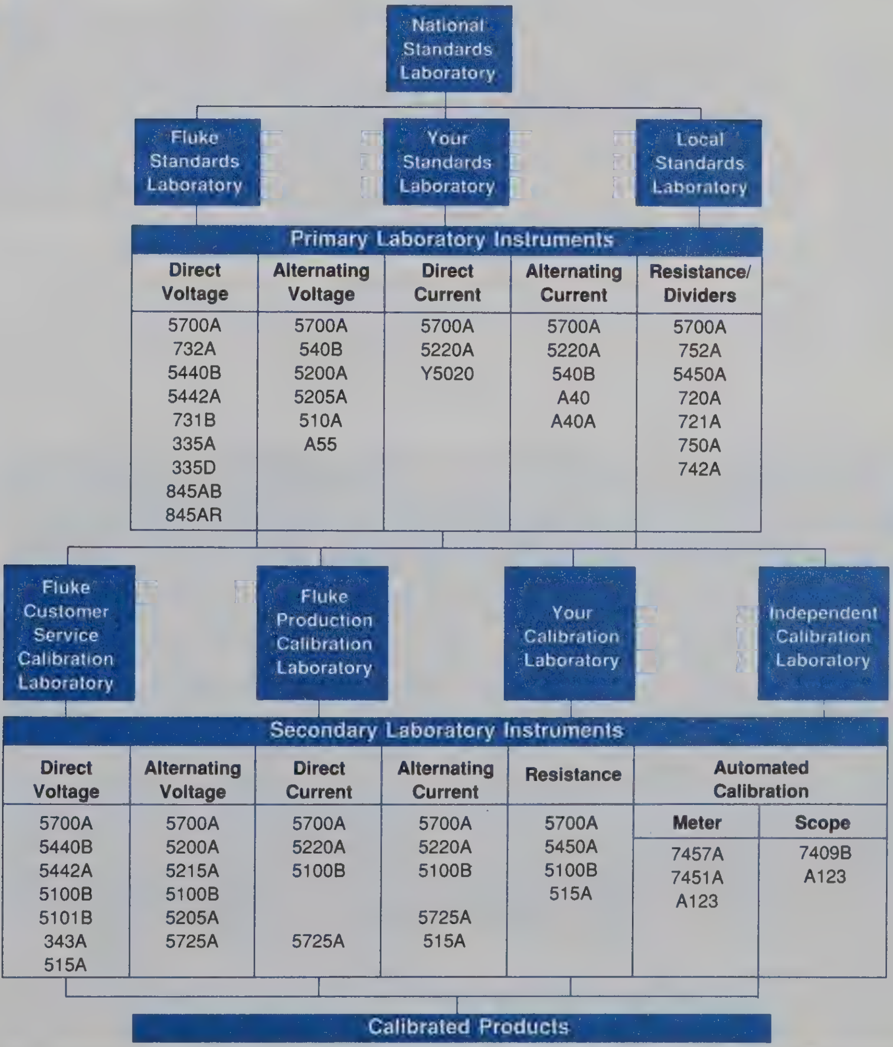
Dividers and Standards Equipment

Model	Basic Uncer-tainty	Stability	Input Range	Page
752A	0.2 ppm - 10:1 0.5 ppm - 100:1	–	1100V	233
Y5020	±0.01%	0.002% in 6 months	0 to 20A	211
720A	0.1 ppm	1.0 ppm/year	0 to 1100V	239
721A	–	–	4000:1 Ratio	238
750A	10 ppm	10 ppm/year	1.1 to 1100V	239
845AB	2%	0.15 µV/hr	1.0 µV to 1000V	240
845AR	3%	0.15 µV/hr	1.0 µV to 1000V	240

Using the Product/Applications Guide

The traceability chart shows you how Fluke calibration products cover your Calibration Lab and Standards Lab workload. This chart will help you select the instrumentation you need in your facility.

Find the position of your lab on the chart. Then refer to the box below for the appropriate products. Each product is fully described in the following pages. Your local Fluke Account Manager will be glad to assist you in matching Fluke instruments and systems to your requirements.


National Standards Laboratory
Fluke Standards Laboratory
Your Standards Laboratory
Local Standards Laboratory
Fluke Customer Service Calibration Laboratory
Fluke Production Calibration Laboratory
Your Calibration Laboratory
Independent Calibration Laboratory
Calibrated Products

Primary Laboratory Instruments

Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Resistance/ Dividers
5700A	5700A	5700A	5700A	5700A
732A	540B	5220A	5220A	752A
5440B	5200A	Y5020	540B	5450A
5442A	5205A		A40	720A
731B	510A		A40A	721A
335A	A55			750A
335D				742A
845AB				
845AR				

Secondary Laboratory Instruments

Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Resistance	Automated Calibration	
					Meter	Scope
5700A	5700A	5700A	5700A	5700A	7457A	7409B
5440B	5200A	5220A	5220A	5450A	7451A	A123
5442A	5215A	5100B	5100B	5100B	A123	
5100B	5100B			515A		
5101B	5205A		5725A			
343A	5725A	5725A	515A			
515A						

Cost-Effective Solutions for the Cal Lab Workload

While a calibrator's parts per million (ppm) specifications are important, focusing on specifications alone is not the best approach to selecting a calibration instrument. Other factors such as reliability, ease of use, expandability, service, and manufacturer service and responsiveness are equally as important as specifications. You need to consider the total cost of ownership.

Satisfying your calibration needs means far more than just buying some calibration hardware. Of course you need to look at the specifications, but make sure you are evaluating performance that fits your needs and not just paper promises.

The real challenge is how to get the most cost-effective workload coverage. Consider your population of instruments. Will you be calibrating ATE systems or handheld DMMs? How high is your volume?

To obtain sufficient workload coverage in the past, many different instruments were required to handle a single calibration task. Single instruments are now capable of multiple tasks. For example, when Fluke introduced the 5100 Series, it replaced the need for six different instruments and was dubbed the "cal lab in a box." With technology advances such as these, the expense of equipping a cal lab is decreasing. A new offering, the 5700A, provides still higher accuracy while maintaining compability with the 5100 Series.

You also need to keep the future in mind. Will you want to automate your calibration process at a later date? If so, sonsider calibration instruments that can be integrated into automated calibration systems. (See page XXX for a description of how Fluke calibration instruments can be expanded into automated systems.) Expandability is an important factor in protecting your instrumentation investment.

A crucial aspect of achieving the best workload coverage is determining the level of accuracy required to calibrate instruments in your workload. For the most cost effective investment, concentrate your on instruments covering the greatest portion of your workload.

Selection Guide

Model	Multimeter Calibration	Direct Voltage Calibration	Alternating Voltage Calibration	Direct Current Calibration	Alternating Current Calibration	Resistance Calibration	Compatible Amplifiers
5700A	•	•	•	•	•	•	5725A, 5205A, 5215A, 5220A
5100B	•	•	•	•	•	•	5205A, 5215A, 5220A
5101B	•	•	•	•	•	•	5205A, 5215A, 5220A
5440B		•					5205A, 5220A
5442A		•					5205A, 5220A
5200A			•				5205A, 5215A
5450A						•	
335A		•					
335D		•					
343A		•					
515A	•	•	•			•	

For Further Information

To help you learn more about calibration and various related subjects, Fluke offers a wide variety of literature. This catalog lists all the technical literature available. Some specific terms of interest are listed below.

Traceability Chart: Derivation of Electrical Units

This full-color poster traces the derivation of electrical units from the basic world standards to the level of instrumentation in your calibration lab. It will be valuable for teaching new technicians derivation of units.

Technical Papers on Newest Technology

A number of technical papers presented at recent metrology conferences around the world are available, describing the latest advances in the field. Ask your Account Manager for a complete list of those available.

Calibration: Philosophy in Practice

This book, a "cal lab classic," describes various aspects of lab operation, types of instrumentation, and the theories underlying them.

Information is included on basic units and standards of measurement, and how traceability is maintained to guarantee the integrity of your measurements.

5700A

GPIB IEEE-488

NEW

5700A

5700A Calibrator

- Covers the complete DMM calibration workload
- Precision performance that is easy to use
- Simplified support with Artifact Calibration
- Compatible to protect your investment

Wide Workload Coverage

The Fluke 5700A is designed to cover the widest portion of today's calibration workload - a wide variety of DMMs from all manufacturers. It delivers direct voltage to 1100V and alternating voltage from 220 µV to 1100V at frequencies from 10 Hz to 1.2 MHz. Cardinal point resistances range from 1Ω to 100 MΩ in x1 and x1.9 decades, including a short. Direct and alternating current are provided to 2.2A, and frequencies for alternating current range from 10 Hz to 10 kHz.

Only one option is offered for the 5700A, Wideband Voltage (-03). It provides flat, low-noise alternating voltage output from 10 Hz to 30 MHz to extend workload coverage to include RF voltmeters. Output may be selected in volts or dBm referenced to 50Ω.

The companion 5725A Amplifier extends the 5700A's workload coverage still further. It increases maximum direct and alternating current to 11A for calibrating the high current ranges of popular low-cost and hand-held DMMs. And it extends the calibrator's alternating volt-hertz product to 1100V at 30 kHz and 750V at 100 kHz to cover the calibration requirements of high-accuracy bench and system meters.

The 5700A is designed to be taken to the workload. In manufacturing applications, test instruments may be calibrated on-site, minimizing production line downtime due to calibration recall.

Low Cost of Ownership

The original purchase price is not the most significant cost associated with owning a high accuracy calibrator. Once the instrument is on the job, a wide range of calibration, maintenance, repair and training requirements increase its cost of ownership beyond the original purchase price many times over.

The 5700A Calibrator was designed to keep those traditional ownership costs down. Its powerful features are easy to use. Advanced internal metrology dramatically reduces support requirements while increasing your confidence in the instrument's performance. And its rugged, modular design increases reliability and makes problems easy to find and repair when they occur.

Simplified Calibration Support

Only three Artifact Standards, a 10V dc reference and 1Ω and 10 kΩ resistance references, are required to calibrate all 5700A ranges and functions to full specifications. The process, running under the control of the calibrator, takes about one hour. Instructions are displayed on the front panel in plain English to prompt the operator when to make various connections and inputs. For added confidence, Fluke recommends that a full verification of the 5700A be performed every two years or as required by your established procedures.

The 5700A does not need to be recalled to the standards laboratory for calibration. Due to its unique, environmentally tolerant design, the 5700A may be calibrated wherever it is used, at any temperature between 15°C and 35°C. Full performance is available for ±5°C of that temperature.

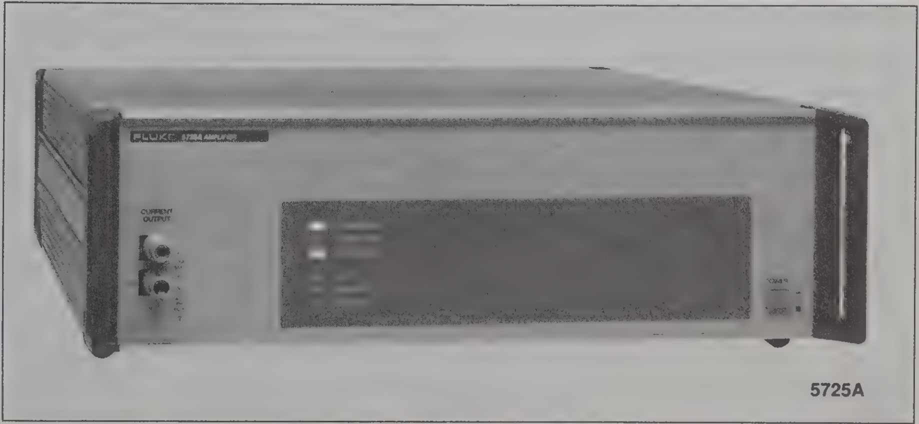
Complete Confidence

Between Artifact Calibrations, the 5700A's performance may be checked against its internal standards. Without adjusting the instrument, an automated procedure is available to check each range and function against internal check standards to increase your confidence that it is within performance tolerances. Should any range be shown to be out of specification, the operator is alerted. All results of this Cal Check process can be printed via RS-232 port. This data can be used to develop control charts to predict the long-term performance of the calibrator.

High Performance That's Easy to Use

In the past, calibration of precision DMMs required a host of complex, manually operated instruments and standards.

The 5700A combines the functions of these instruments to dramatically simplify DMM calibration. Values are entered on the simple numeric keyboard and displayed on the front



5725A

panel. The command is confirmed with the ENTER key. To verify the reading of the UUT, the operator simply adjusts the output knob and the error is displayed directly in ppm or %. Output values can be selected for editing using the arrow keys. Using the OFFSET and SCALE keys, the 5700A compensates for meter zero offset and scale errors and directly displays linearity errors at any scale level. The x10 and ÷10 keys simplify work on meters requiring calibration levels in even decade steps. Just multiply or divide any output value by pressing the corresponding key.

To protect the operator and UTT, limits on maximum output can be preset. For additional operator protection, the 5700A resets to standby mode when output is increased to more than 22V.

Compatibility

The 5700A is designed to protect your investment in existing Fluke instruments and procedures. For example, a Fluke 5205A or 5215A voltage amplifier, and a Fluke 5220A transconductance amplifier may be connected directly to the 5700A through dedicated ports. In automated systems, the 5700A may be configured to emulate a 5100B so that existing procedures can be run with minimal modification.

Designed for Reliability

Another important factor in keeping instrument cost of ownership low is product reliability. Throughout its design and manufacture, the 5700A has been engineered to be the most reliable instrument of its type. Statistical process control techniques assure that quality is maintained, from component test through final assembly. Every 5700A is subjected to more than 2g of random vibration to prevent subtle imperfections from causing failures later on. A stiff chassis permits the 5700A to be moved with minimal risk of damage. Internal DIN connectors seal out potential environmental problems while keeping circuit boards firmly connected. Internal diagnostics exercise both digital and analog functions and can isolate problems to the board level, so repair often requires nothing more than the replacement of a plug-in module.

Specification Summary*

To simplify evaluation of how the 5700A covers your calibration workload, use the 5700A absolute uncertainty specifications.

Specifications

DC Voltage

Range	Resolution	Absolute Uncertainty ±5°C from calibration temperature			
		24 Hours	90 Days	180 Days	1 Year
		±(ppm output + µV)			
220 mV	10 nV	6.5 + .75	7 + .75	8 + .75	9 + .8
2.2V	100 nV	3.5 + 1.2	6 + 1.2	7 + 1.2	8 + 1.2
11V	1 µV	3.5 + 3	5 + 4	7 + 4	8 + 4
22V	1 µV	3.5 + 6	5 + 8	7 + 8	8 + 8
220V	10 µV	5 + 100	6 + 100	8 + 100	9 + 100
1100V	100 µV	7 + 600	8 + 600	10 + 600	11 + 600

Resistance

Nominal Value	Absolute Uncertainty of Characterized Value ±5°C from calibration temperature			
	24 Hours	90 Days	180 Days	1 Year
Ω	±ppm			
0	50 µΩ	50 µΩ	50 µΩ	50 µΩ
1	85	95	100	110
1.9	85	95	100	110
10	26	28	30	33
19	24	26	28	31
100	15	17	18	20
190	15	17	18	20
1k	11	12	13	15
1.9k	11	12	13	15
10k	9	11	12	14
19k	9	11	12	14
100k	11	13	14	16
190k	11	13	14	16
1M	16	18	20	23
1.9M	17	19	21	24
10M	33	37	40	46
19M	43	47	50	55
100M	110	120	125	130

Absolute Uncertainty includes stability, temperature coefficient, linearity, line and load regulation, and the traceability of external standards. You do not need to add anything to determine the ratios between 5700A uncertainties and the uncertainties of your calibration workload.

**Complete 5700A and 5725 specifications are available. Ask for Fluke document A0296.*

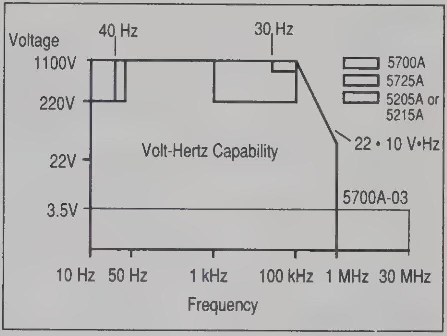
Resistance

Seventeen passive resistance values are supplied in x1.0 and x1.9 mutiples, plus a short to allow complete resistance calibration without moving test leads. Actual values assigned during calibration are displayed and used as reference points for error calculations.

For calibration of highter accuracy meters, 4-wire output connection is provided, with absolute uncertainties as shown in the table. Active 2-wire compensation is available for calibration of less accurate ohmmeters with 2-wire inputs. This feature substantially eliminates errors due to test lead resistance, and may be selected for resistance values up to 19 kΩ.

AC Voltage

Range	Resolution	Frequency	Absolute Uncertainty ± 5°C from calibration temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + µV)			
2.2 mV	1 nV	10-20	500 + 5	550 + 5	600 + 5	600 + 5
		20-40	200 + 5	220 + 5	230 + 5	240 + 5
		40-20k	100 + 5	110 + 5	120 + 5	120 + 5
		20k-50k	340 + 5	370 + 5	390 + 5	410 + 5
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30
22 mV	10 nV	10-20	500 + 6	550 + 6	600 + 6	600 + 6
		20-40	200 + 6	220 + 6	230 + 6	240 + 6
		40-20k	100 + 6	110 + 6	120 + 6	120 + 6
		20k-50k	340 + 6	370 + 6	390 + 6	410 + 6
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30
220 mV	100 nV	10-20	500 + 16	550 + 16	600 + 16	600 + 16
		20-40	200 + 10	220 + 10	230 + 10	240 + 10
		40-20k	95 + 10	100 + 10	110 + 10	110 + 10
		20k-50k	300 + 10	330 + 10	350 + 10	360 + 10
		50k-100k	750 + 30	800 + 30	850 + 30	900 + 30
		100k-300k	940 + 30	.1% + 30	.11% + 30	.11% + 30
		300k-500k	.15% + 40	.17% + 40	.17% + 40	.18% + 40
		500k-1M	.30% + 100	.33% + 100	.35% + 100	.36% + 100
2.2V	1 µV	10-20	500 + 100	550 + 100	600 + 100	600 + 100
		20-40	150 + 30	170 + 30	170 + 30	180 + 30
		40-20k	70 + 7	75 + 7	80 + 7	85 + 7
		20k-50k	120 + 20	130 + 20	140 + 20	140 + 20
		50k-100k	230 + 80	250 + 80	270 + 80	280 + 80
		100k-300k	400 + 150	440 + 150	470 + 150	480 + 150
		300k-500k	.10% + 400	.11% + 400	.12% + 400	.12% + 400
		500k-1M	.20% + 1 mV	.22% + 1 mV	.23% + 1 mV	.24% + 1 mV
22V	10 µV	10-20	500 + 1 mV	550 + 1 mV	600 + 1 mV	600 + 1 mV
		20-40	150 + 300	170 + 300	170 + 300	180 + 300
		40-20k	70 + 70	75 + 70	80 + 70	85 + 70
		20k-50k	120 + 200	130 + 200	140 + 200	140 + 200
		50k-100k	230 + 400	250 + 400	270 + 400	280 + 400
		100k-300k	500 + 1.7 mV	550 + 1.7 mV	550 + 1.7 mV	600 + 1.7 mV
		300k-500k	.12% + 5 mV	.13% + 5 mV	.13% + 5 mV	.14% + 5 mV
		500k-1M	.26% + 9 mV	.28% + 9 mV	.29% + 9 mV	.30% + 9 mV
			±(ppm output + mV)			
220V	100 µV	10-20	500 + 10	550 + 10	600 + 10	600 + 10
		20-40	150 + 3	170 + 3	170 + 3	180 + 3
		40-20k	75 + 1	80 + 1	85 + 1	90 + 1
		20k-50k	200 + 4	220 + 4	240 + 4	250 + 4
		50k-100k	500 + 10	550 + 10	600 + 10	600 + 10
		100k-300k	.15% + 110	.15% + 110	.16% + 110	.16% + 110
		300k-500k	.50% + 110	.52% + 110	.53% + 110	.54% + 110
		500k-1M	1.20% + 220	1.25% + 220	1.25% + 220	1.30% + 220
1100V	1 mV	50-1k	75 + 4	80 + 4	85 + 4	90 + 4



AC Voltage, 5725A Amplifier

Range	Resolution	Frequency	Absolute Uncertainty ± 5°C from calibration temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + mV)			
1100V	1 mV	40-1k	75 + 4	80 + 4	85 + 4	90 + 4
		1k-20k	105 + 6	125 + 6	135 + 6	165 + 6
		20k-30k	230 + 11	360 + 11	440 + 11	600 + 11
750V		30k-50k	230 + 11	360 + 11	440 + 11	600 + 11
		50k-100k	600 + 45	.13% + 45	.16% + 45	.23% + 45

DC Current

Range	Resolution	Absolute Uncertainty ±5°C from calibration temperature			
		24 Hours	90 Days	180 Days	1 Year
	nA	±(ppm output + nA)			
220 µA	.1	45 + 10	50 + 10	55 + 10	60 + 10
2.2 mA	1	45 + 10	50 + 10	55 + 10	60 + 10
22 mA	10	45 + 100	50 + 100	55 + 100	60 + 100
	µA	±(ppm output + µA)			
220 mA	.1	55 + 1	60 + 1	65 + 1	70 + 1
2.2A	1	80 + 30	85 + 30	90 + 30	95 + 30
5725A Amplifier:					
11A	10	380 + 470	385 + 480	390 + 480	400 + 480

AC Current

Range	Resolution	Frequency	Absolute Uncertainty ± 5°C from calibration temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + nA)			
220 µA	1 nA	10-20	650 + 30	700 + 30	750 + 30	800 + 30
		20-40	350 + 25	380 + 25	410 + 25	420 + 25
		40-1k	120 + 20	140 + 20	150 + 20	160 + 20
		1k-5k	650 + 1 µA	750 + 1 µA	800 + 1 µA	850 + 1 µA
		5k-10k	.40% + 4 µA	.44% + 4 µA	.46% + 4 µA	.48% + 4 µA
2.2 mA	10 nA	10-20	650 + 50	700 + 50	750 + 50	800 + 50
		20-40	350 + 40	380 + 40	410 + 40	420 + 40
		40-1k	120 + 40	140 + 40	150 + 40	160 + 40
		1k-5k	650 + 2 µA	750 + 2 µA	800 + 2 µA	850 + 2 µA
		5k-10k	.4% + 4 µA	.44% + 4 µA	.46% + 4 µA	.48% + 4 µA
22 mA	100 nA	10-20	650 + 500	700 + 500	750 + 500	800 + 500
		20-40	350 + 400	380 + 400	410 + 400	420 + 400
		40-1k	120 + 400	140 + 400	150 + 400	160 + 400
		1k-5k	650 + 10 µA	750 + 10 µA	800 + 10 µA	850 + 10 µA
		5k-10k	.4% + 20 µA	.44% + 20 µA	.46% + 20 µA	.48% + 20 µA
		Hz	+(ppm output + µA)			
220 mA	1 µA	10-20	650 + 5	700 + 5	750 + 5	800 + 5
		20-40	350 + 4	380 + 4	410 + 4	420 + 4
		40-1k	300 + 4	330 + 4	350 + 4	360 + 4
		1k-5k	700 + 50	750 + 50	800 + 50	850 + 50
		5k-10k	.4% + 100	.44% + 100	.46% + 100	.48% + 100
2.2A	10 µA	40-1k	600 + 40	650 + 40	700 + 40	750 + 40
		1k-5k	700 + 100	750 + 100	800 + 100	850 + 100
		5k-10k	.80% + 200	.90% + 200	.95% + 200	1.0% + 200
5725A Amplifier:						
11A	100 µA	40-1k	370 + 170	400 + 170	440 + 170	460 + 170
		1k-5k	800 + 380	850 + 380	900 + 380	950 + 380
		5k-10k	.3% + 750	.33% + 750	.35% + 750	.36% + 750

Current

The 5700A supplies direct alternating current to 2.2A, extended to 11A with the 5725A Amplifier or to 20A with the 5220A Transconductance Amplifier. 5700A current output is available on front or rear voltage output terminals. For convenience in calibrating meters with separate current terminals, 5700A outputs may also be directed either to an auxiliary front panel current terminal or to 5725A front or rear terminals. Thsi allows automated meter calibration without moving test leads.

For system applications, a rear panel current guard provides a voltage follower output for guarding low level current through longer system cables.

Wideband AC Voltage (Option -03)

Specifications apply to the end of the cable and 50Ω termination used for calibration:

Range		Resolution	Absolute Uncertainty ±5°C from calibration temperature 30 Hz-500 kHz			
Volts	dBm		24 Hours	90 Days	180 Days	1 Year
			±(% output + µV)			
1.1 mV	-46	10 nV	.2 + .4	.4 + .4	.6 + .4	.8 + 2
3 mV	-37	10 nV	.2 + 1	.35 + 1	.5 + 1	.7 + 3
11 mV	-26	100 nV	.2 + 4	.35 + 4	.5 + 4	.7 + 8
33 mV	-17	100 nV	.2 + 10	.3 + 10	.45 + 10	.6 + 16
110 mV	-6.2	1 µV	.2 + 40	.3 + 40	.45 + 40	.6 + 40
330 mV	+3.4	1 µV	.2 + 100	.25 + 100	.35 + 100	.5 + 100
1.1V	+14	10 µV	.2 + 400	.25 + 400	.35 + 400	.5 + 400
3.5V	+24	10 µV	.15 + 500	.2 + 500	.3 + 500	.4 + 500

Frequency	Frequency Resolution	Amplitude Flatness, 1 kHz Reference Voltage Range		
		1.1 mV	3 mV	>3 mV
Hz	Hz	±%		
10-30	.01	.3	.3	.3
30-120	.01	.1	.1	.1
120-1.2k	.1	.1	.1	.1
1.2k-12k	1	.1	.1	.1
12k-120k	10	.1	.1	.1
120k-1.2M	100	.2 + 3 µV	.1	.1
1.2M-2M	100k	.2 + 3 µV	.1	.1
2M-10M	100k	.2 + 3 µV	.1	.1
10M-20M	1M	.2 + 3 µV	.3	.2
20M-30M	1M	1.5 + 15 µV	1.5	1

Additional Operating Information:
dBm reference = 50Ω
Range boundaries are at voltage points, dBm levels are approximate.

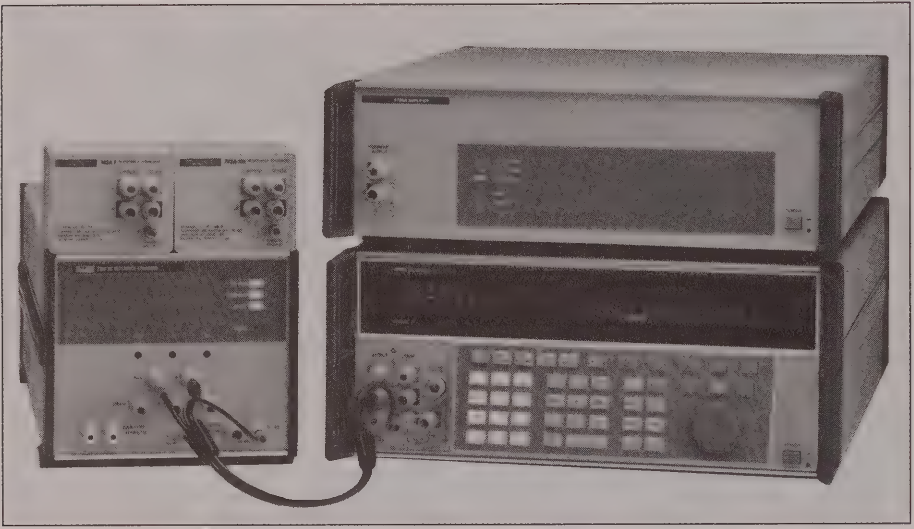
$$\text{dBm} = 10 \log \left(\frac{\text{Power}}{1\ \text{mW}} \right),$$

for 50Ω: 0 dBm = 1 mW across 50Ω = 0.22361V
Minimum Output: 300 µV (-57 dBm)
Frequency Uncertainty: ±0.01%
Overload Protection: A short circuit on the wideband output will not result in damage. After settling time, normal operation is restored upon removal.

General Specifications

Warm-up Time: 2x the time since last warmed up, to a maximum of 30 minutes.
System Installation: Rear output configuration and rackmount kit available.
Standard Interfaces: IEEE-488, RS-232, 5725A, 5205A or 5215A, 5220A, phase lock in (BNC), phase reference out (BNC).
Temperature Performance: Operating: 0°C to 50°C. Calibration: 15°C to 35°C. Storage: -40°C to 75°C.
Relative Humidity: Operating: <90% to 30°C, <70% to 40°C, <40% to 50°C. Storage <95%, non-condensing
Safety: Designed to comply with UL 1244 (1987); IEC 348-1978l IEC 66E (CO) 4; CSA 556B.
Guard Isolation: 20 volts
EMI/RFI: Designed to comply with FCC Rules Part 15, Subpart J, Class B; VDE 0871, Class B.
Reliability: MIL-T-28800D, para. 3.13.3
Line Power: 47 to 63 Hz; ±10% allowed about selectable nominal line voltage: 100V, 110V, 115V, 120V, 200V, 220V, 230V, 240V. Maximum power: 5700A, 300VA; 5725A, 750VA.
Size:
5700A: Height 17.8 cm (7 in), standard rack increment, plus 1.5 cm (o.6in) for feet; Width 43.2 cm (17 in), standard rack width; Depth 63.0 cm (24.8), overall; 57.8 cm (22.7 in), rack depth. 5725A: Height 13.3 cm *5.25 in); Width and depth same as 5700A. Both units project 5.1 cm (2 in) from rack front
Weight: 5700A: 27kg (62 lbs); 5725A: 32kg (70 lbs)

5700A



All ranges and functions of the 5700A, 5725A and Wideband Voltage option may be calibrated using just three Artifact Standards.

Calibration Requirements

Calibrating the 5700A to full specified absolute uncertainty requires only the following standards:

Fluke Standard	Traceable Quantity	Nominal Value	Uncertainty*
732A	Voltage	10V	±1.5 ppm
742A-1	Resistance	1Ω	±10 ppm
742A-10k	Resistance	10 kΩ	±4 ppm

**Relative to national standards*

The 5700A's simple, built-in, self-prompting calibration procedure is designed to use the portable Fluke standards to completely calibrated all of it functions.

Calibration may be done at any temperature from 15°C to 35°C without change to any specification except for resistance. Resistance specifications are modified by a small temperature coefficient when the 5700A is calibrated below 19°C or above 24°C.

You may use standards with different uncertainties than given in the table at left. Absolute uncertainty must then be modified by the algebraic difference between the uncertainty of the standard used and that in the table. For example if the dc voltage standard has an uncertainty of ±2.5 ppm, 5700A DC Voltage absolute uncertainty specifications will all be increased by ±1 ppm. Note that dc and ac current specifications include the uncertainties of both the dc voltage and resistance standards that are used.

Ordering Information

Model

January 1989 prices

5700A Calibrator	$19,950
5700A-01 Calibrator, Rear Output Option*	0
5725A Amplifier	7950
5725A-01 Amplifier, Rear Output Option*	0

**Factory installed only*

Option

5700A-03 Wideband AC Voltage	3995

Accessories (Also see page 485)

5440A-7002 Low Thermal Cable Set	350
732A DC Voltage Reference Standard	3800
742A-1 1Ω Resistance Standard	795
742A-10k 10 kΩ Resistance Standard	695
Y5701 Cable for 5205A or 5215A	250
Y5702 Cable for 5220A	250
Y5737 Rack Mount Kit with 24" slides for 5700A*	110
Y5735 Rack Mount Kit with 24" slides for 5725A*	110
Y8021 Shielded IEEE-488 Cable, 1 meter	130
Y8022 Shielded IEEE-488 Cable, 2 meters	145
Y8023 Shielded IEEE-488 Cable, 4 meters	155

**Note: These rack slides allow for side ventilation.*

Service and Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-5700A Repair (w/calibration)	227
SC2-5700A Cal	95
SC1-5725A Repair (w/calibration)	110
SC2-5725A Cal	63

5100B Series

GPIB
IEEE-488

RS-232

New and Improved

5100B

5100B Series Calibrators

- New and improved version of the world's most popular multifunction calibrator
- Cost-effective multimeter calibration to 4½ digits
- Five functions: Direct or alternating voltage or current plus resistance
- New front panel, new output terminals, and updated control panel
- Modern production methods offer superior quality
- Unique cassette tape drive option available for storing procedures
- Compatible with Fluke 7411C and 7411PC based systems, 5700A Calibrator, 5205A/5215A Power Amplifiers, and 5220A Transconductance Amplifier

The 5100B Series Calibrators are the world's leading calibrators for analog and digital multimeters to 4½ digits. Dependability, five-function versatility and cost effectiveness have made the 5100B Series Calibrators basic equipment for nearly every calibration laboratory.

Now these calibrators offer even more value. DC voltage uncertainty is 40 ppm; Basic AC uncertainty is 350 ppm. The front panel includes new, high-voltage safety terminals together with control grouping optimized for user friendliness. Quality and reliability are also enhanced with modern manufacturing methods including statistical process control (SPC).

The versatility of the 5100B Series Calibrators is unmatched at any price. They are compatible with the popular Fluke 7411C and 7411PC based Calibration Systems, the Navy's MECCA Systems and the new Fluke 5700A Multifunction Calibrator. Enhanced capability is also available with the 10 MHz Wideband Option and the capability to directly drive the Fluke 5220A 20A Transconductance Amplifier and the 5205A or 5215A High Voltage Amplifier.

5100B Series Increases Throughput

A large share of the workload of meter calibration laboratories and production lines consists of analog and digital meters with 4½ digit or less resolution. There are hundreds of different meters in this category representing different manufacturers, with no standard format for meter specifications. Even meters from the same manufacturer are often specified differently. This creates a real problem for any cal lab manager.

Until Fluke introduced the 5100 Series, calibration lab and production line managers were forced to write elaborate test procedures to convert the complex specifications into a step-by-step procedure for inexperienced workers. Or they could use expensive, highly-skilled technical people to perform the test without a procedure. These methods sometimes exceeded the initial cost of the instrument by three to five times over a 5-year period.

Operating the 5100B Series is simple, making it easy to train your operators. And all data is entered via a calculator-type keyboard. No need to convert volts to dBm or dBm to volts, for example. And the 5100B Series performs the mathematical computations associated with calculating the error of the unit-under-test (UUT) – in % or in dB. It then indicates to the operator whether the UUT passed or failed, according to its specified uncertainty and the magnitude of the error.

The 5100B Series calibrates meters quickly and efficiently. It is no longer necessary to gather together separate calibration instruments requiring complex interconnection and operation. A single 5100B Series does the whole job.

5101B Has System Features

The 5101B is designed for the user who needs the automated features of a large computer aided calibration system without the hardware and software costs of a large system.

A typical calibration procedure consists of forty or fifty separate steps. For most benchtop systems, each step must be loaded into the calibrator – an operation that is slow and prone to human error. The 5101B has a built-in cassette tape deck to store calibration procedures and step through them under microprocessor control.

Initially, the operator records the procedure on a mini cassette. Once recorded, the procedure can be repeated in a fraction of the usual time. Preparing the calibration tape and operating the 5101B, requires no special knowledge of computers or computer languages. Using a printer and interface option with the 5101B, you can document both the calibration procedure and the test results with a hard-copy record.

5102B Has Rugged Case

The 5102B is similar to a 5100B but constructed in a rugged combination case with removable sealed end covers for military applications. It is not rackmountable.

Automated Calibration

The 5100B Series can be used in computer-aided calibration applications by adding a Fluke 1722A Instrument Controller and 7411B Calibration Software. Examples of calibration procedures are included in the software packages. Consult your local sales office for details.

Extended Power and Current Capabilities

The 5205A Precision Power Amplifier and the 5220A Transconductance Amplifier will operate as an integrated system with either a 5100B, 5101B, or 5102B. The purpose is to extend the voltage and current sourcing capabilities beyond the basic built-in capabilities of the 5100B Series Calibrators.

High voltage loading may be extended from 6 mA maximum to 100 mA maximum at 1100V for direct voltage. And alternating volt-Hertz limits may be extended from 20V at 50 kHz to 1100V at 50 kHz. Current sourcing may be extended from 2A to 20A.

A Y5000 Interface/Buffer is needed to integrate a 5205A and/or a 5220A with 5100B Series. It connects to the rear panels and preserves the advantage of single-point control of calibration, automatic error calculation, entry limit protection, etc. The system is operated and controlled using only the front panel of the 5100B/5101B or procecures stored on a 5101B mini cassette.

Specifications

Technical Specifications

Direct Voltage

Range	Resolution	Maximum Current	Ripple and Noise (10 Hz to 3 kHz, NL to FL, RMS)
20 mV	0.1 µV	Limited by 50Ω output resistance or 25 mA using 50Ω overide	0.01 of setting +25 µV**
200 mV	1 µV		
2V	10 µV		
20V	100 µV	25 mA 1000 pF	0.02% of setting + 50 µV
200V	1 mV	10 mA/ 400 pF*	0.05% of setting (open to 20 kΩ) 0.1 of setting (20 kΩ to full load)
1100V	10 mV	6 mA/ 400 pF*	0.05% of setting

**100 mA/1500 pF with 5205A, Y5000 and Y5001*
***Double both terms for divider override mode*

Uncertainty: ±(0.004% of setting +0.001% of range +5 µV) for all ranges, for 6 months, 20°C to 30°C ambient, non-override; ±(0.005% of setting +0.2 mV) for divider override mode
Temperature Coefficient: Above 30°C and below 20°C, ±(5 ppm of setting +1 ppm of range +1 µV)/°C to 200V, ±(5 ppm of setting +2 ppm of range)/°C, 200V to 1100V
Short Term Stability: (For 10 minutes from 0°C to 50°C) ±(10 ppm of setting +2 ppm of range +5 µV) to 500V; ±25 ppm of setting, 500V to 1100V
Load Regulation: (External Sense) ±10 ppm from 2V to 1100V, no-load to full-load. (Internal Sense) same as external except full-load is 400Ω

Alternating Voltage

Range*	Resolution	Maximum Load	Total Harmonic Distortion and Noise
20 mV	0.1 µV	Limited by 50Ω output resistance	Bandwidth of 10 Hz to 200 kHz, Distortion, line interference + noise including random spikes **20V and Higher** 50 Hz to 10 kHz: 0.08% of output rms **Below 20V** 50 Hz to 10 kHz: (0.05% of output + 10 µV) rms 10 kHz to 50 kHz: (0.08% of output + 20 µV) rms
200 mV	1 µV		
2V	10 µV	2 kΩ/ 1000 pF	
20V	100 µV	25 mA/ 1000 pF	
200V	1 mV	10 mA/ 400 pF	
1100V	10 mV	6 mA/ 400 pF**	

** Can be set in dBm where 0 dBm + 1 mW in 6008 + 0.7746V*
***200 mA/1500 pF with 5205A, Y5000 and Y5001*

Uncertainty: ±(0.035% of setting +0.005% of range +50 µV) from 50 Hz to 10 kHz and ±(0.06% of setting +0.008% of range +50 µV) from 10 kHz to 50 kHz for 6 months, 20°C to 30°C ambient
Frequencies Available (Hz): 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, and 900 for all voltage ranges.

Frequencies Available (kHz):

Voltage Range	1	2	3	4	5	6	7	8	9	10	20	30	40	50
110V to 1100V	•	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
20V to 110V	•	•	•	•	•	•	•	•	•	•	•	Δ	Δ	Δ
1 mV to 20V	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Δ With 5205A, Y5000, and Y5001

Frequency Uncertainty: ±3%
Temperature Coefficient: Above 30°C and below 20°C ±(20 ppm of setting +2 ppm of range)/°C for amplitude, ±0.1%/°C for frequency
Short Term Stability: ±(0.01% of range +10 µV) for 10 minutes from 0°C to 50°C
Load Regulation: External Sense, ±200 ppm from 0.2V to 1100V, no-load to full-load; Internal Sense, same as external except regulation for voltages <0.2V is expressed as an output impedance of 50Ω

Direct Current

Range	Resolution	Compliance Voltage	Ripple and Noise
200 µA	1 nA	0 to 10V	(0.05% of output +0.01 µA) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 µA		
2A*	10 µA	0 to 2.1V	

**20A with 5220A, Y5000, and Y5002*

Uncertainty: ±0.015% of setting +0.002% of range +0.01 µA) for compliance voltage up to 1V. Add 0.002% of setting per volt above 1V rms. Applies for 6 months and 20°C to 30°C ambient
Temperature Coefficient: Above 30°C and below 20°C ±(10 ppm of setting +2 ppm of range)/°C
Short Term Stability: ±(50 ppm of setting +5 ppm of range +0.002 µA) for 10 minutes from 0°C to 50°C
Load Regulation: ±20 ppm/volt for change in output voltage from 1 volt to maximum compliance voltage

Alternating Current

Range	Resolution	Compliance Voltage	Total Harmonic Distortion & Noise
200 µA	1 nA	0 to 7V	(0.05% of output +0.01 µA) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 µA		
2A*	10 µA	0 to 1.4V	

**20A with 5220A, Y5000, and Y5002*

Uncertainty: ±0.05% of setting +0.005% of range +0.02 µA) for compliance voltage up to 1V rms (50 Hz to 1 kHz). Add 0.005% of setting per volt above 1V rms. Applies for 6 months in 20°C to 30°C ambient
Temperature Coefficient: Above 30°C and below 20°C ±(25 ppm of setting +10 ppm of range +0.2 nA)/°C for amplitude, +0.1%/°C for frequency
Short Term Stability: ±(0.014% of setting +0.002% of range +0.4 µA) for 10 minutes from 0°C to 50°C

Load Regulation: ±(50 ppm +20 nA)/volt for change in output voltage from 1 volt to maximum compliance voltage

Resistance

Range: 1Ω to 10 MΩ in decade steps
Uncertainty: ±0.003%, except ±0.015% (1Ω), ±0.010% (10Ω and 1 MΩ), and ±0.030% (10 MΩ) assumes 4 terminal below 100 kΩ. 6 mo 20°-30°C
Power Dissipation: 1W maximum except 100 mW max (1 MΩ) and 10 mW max (10 MΩ)
Temperature Coefficient: Above 30°C and below 20°C, ±5 ppm/°C except ±10 ppm/°C (1Ω and 10Ω), ±10 ppm/°C up to 40°C (10 MΩ), and ±50 ppm/°C above 40°C (10 MΩ)

Extended Specifications

Direct Voltage (with 5205A)

Range: ±100V to ±1100V, with 10 mV resolution
Maximum Load: 100 mA; 1500 pF
Uncertainty: ±(0.07% of setting +20 mV), for 6 months, 20°C to 30°C ambient
Line-Related Noise: ≤50 mV rms
Random Noise: ≤100 mV rms, 1 MHz bandwidth

Alternating Voltage (with 5205A or 5215A)

Voltage Range: 100V to 1100V rms, with 10 mV resolution
Maximum Load: 200 mA, decreasing linearly to 140 mA from 100 Hz to 50 Hz; 1500 pF
Voltage Uncertainty: ±(0.08% of setting +0.1V) for 50 Hz to 10 kHz; ±(0.12% of setting + 0.15V) for 10 kHz to 50 kHz, for 6 months, 20°C to 30°C ambient
Frequency Range: Discrete selections from 50 Hz to 50 kHz with 1 MSD resolution
Frequency Uncertainty: ±3%
Harmonic Distortion and Noise: 0.1% of setting from 50 Hz to 20 kHz, 0.2% of setting from 20 kHz to 50 kHz, for bandwidth of 10 Hz to 1 MHz

Direct Current (with 5220A)

Range: ±1A to ±19.9999A, with 100 µA resolution
Compliance Voltage: 0 to 4V
Uncertainty: ±(0.025% of setting +1 mA), for 6 months, 20°C to 30°C ambient
Ripple and Noise: 0.05% of setting +1 mA rms, 10 Hz to 3 kHz bandwidth

Alternating Current (With 5220A)

Current Range: 1A to 19.9999A rms, with 100 µA resolution
Compliance Voltage: 0 to 3V rms
Current Uncertainty: ±(0.07% of setting +1 mA) rms from 50 Hz to 1 kHz, ±(0.07% of setting +1 mA) x frequency (in kHz) from 1 kHz to 5 kHz, for 6 months, 20°C to 30°C ambient
Frequency Range: Discrete selections from 50 Hz to 5 kHz with 1 MSD resolution
Frequency Uncertainty: ±3%
Harmonic Distortion and Noise: ±(0.07% of setting +1 mA) rms, for bandwidth of 10 Hz to 300 kHz

Option Specifications

Wideband aV Option (-03)

Option -03 is a high accuracy, low noise, extremely flat alternating voltage source which increases the frequency coverage of the 5100B Series from its standard of 50 Hz to 50 kHz to 10 Hz to 10 MHz. This option enables the 5100B Series to calibrate wideband meters. A dedicated front panel BNC connector provides ac output from 300 µV (-57.5 dBm) to 3.1623V (+23 dBm) into 50Ω impedance. The output is programmable from the front panel or I/O interface in volts or in dBm (where 0 dBm equals 1 mW into 50Ω). Using a simple formula for calculation of a correction factor and the NEW REF feature, the wideband output can be directly programmed for dBm referenced to other impedances.

With the EDIT control the error of wideband meters can be calculated in % or in dB. With the EDIT control and NEW REF, you may test the frequency response of meters. This method provides a direct reading in percent or dB, ideal for making Bode plots.
Range: 10 Hz to 10 MHz

Amplitude Uncertainty, at 1 kHz, Terminated in 50Ω*

Voltage Range	Approx dBm Range	±(% of Setting + % of Range)
1V-3.1623V	+13 to +23	0.25 + 0.25
0.31624V-0.99999V	+3 to +13	0.5 + 0.25
0.1V-0.31623V	-7 to +3	0.75 + 0.25
31.624mV-99.999mV	-17 to -7	1.0 + 0.25
10mV-31.623mV	-27 to -17	1.25 + 0.25
3.1624mV-9.9999mV	-37 to -27	1.5 + 0.25
1mV-3.1623mV	-47 to -37	1.75 + 0.25
300µV-0.99999 mV	-57.5 to -47	2.0 + 0.25

**For 6 months, 20°C to 30°C ambient*

Amplitude Flatness*
10 Hz to 30 Hz: ±0.3%
30 Hz to 1 MHz: ±0.25%
1 MHz to 5 MHz: ±0.25% above 1 mV, ±0.6% ≤1 mV
5 MHz to 10 MHz: ±0.6%

**Using 1 foot of RG 58U cable terminated in 50Ω*

Temperature Coefficient: Above 30°C and below 20°C ±(0.1 times basic accuracy)/°C for amplitude; ±0.25%/°C for frequency
Harmonics: -40 dB or lower relative to fundamental for each frequency except -32 dB above 5 MHz
Spurious Outputs: -50 dB or lower relative to fundamental for each frequency
Frequency Resolution: 1 MSD
Frequency Uncertainty: ±3%

IEEE-488 Interface Option (-05)

This interface allows the 5100 Series B to be used in a system compatible with IEEE Std 488-1978. System control is via the Fluke 1722A or 1752A Instrument Controller or any host computer. Address coding is done using logic switches accessible on the rear panel. Data is transmitted bi-directionally in ASCII coded format. The following subsets are supported: SH1, AH1, T6, L4, SR1, RL1, DC1, and E2.

Bit Serial Interface Option (-06)

Provides compatibility with EIA Standard RS-232-C or 20 mA current loops. Thirteen baud rates are available from 50 to 9600 and either one or two stop-bits can be set up. Selection is made via rear panel logic switches.

General Specifications

Shock and Vibration: Meets requirements of MIL-T-28800 for Class 5, Style E equipment
Temperature
5100B and 5102B: 0°C to 50°C operating; -20°C to +65°C non-operating
5101B: (With mini cassette tape) +10°C to +40°C operating; +4°C to +50°C, non-operating. Without mini cassette: same as 5100B
Relative Humidity: 185% to 35°C, ≤70% to 40°C, ≤50% to 50°C
Power: 100, 110, 115, 120, 200, 220, 230, 240V ac, switch-selectable ±10%, 50 Hz to 60 Hz. 200VA (5100B) or 220VA (5101B) with all options Size: 22.2 cm H x 60.3 cm W x 43.2 cm L (8.75 in H x 17 in W x 23.75 in L)
Weight
5100B: 30.4 kg (67 lb) basic, 32.7 kg (72 lb) with all options
5101B: 32.7 kg (72 lb) basic, 34.9 kg (77 lb) with all options
5102B: 35.8 kg (79 lb) basic, 38.1 kg (84 lb) with all options
Included: Manual, power cord, serialized and dated Calibration Certificate. Also one mini cassette tape with 5101B

Ordering Information

Models

January 1989 prices

5100B Calibrator	$11,450
5101B Calibrator, w/procedure storage	14,400
5102B 5100B in portable case	15,250
5205A* Power Amplifier	9950
5220A* Transconductance Amplifier	5650

** Y5001 or Y5002 cable and Y5000 interface required when used with 5100B Series Calibrator*

Options (for 5100B, 5101B, 5102B)

-03 Wideband AC Voltage	3100
-05 IEEE-488 Interface	650
-06 EIA RS-232-C Interface	650

Accessories (Also see page 485)

5100B-7003K Fiberglass Case, for 5100B/5101B	1095
5100B-7005K Module Extender Kit	550
M08-205-600 8-3/4" Rack Adapter, 5100B/5101B	110
M00-280-610* 24" Rack Slides	130
Y5000 Interface Buffer for 5205A, 5215A and 5220A	600
Y5001 Cable for 5205A/5215A and Y5000	275
Y5002 Cable for 5220A and Y5000	240
Y8021 1m Cable for IEEE-488 bus	130
Y8022 2m Cable for IEEE-488 bus	145
Y8023 4m Cable for IEEE-488 bus	155
Y8004 1.5m Printer Cable for RS-232-C	110
Y8007 10-pack of mini cassettes for 5101B	150

**Requires M08-205-600*

National Stock Numbers

5100B	6625-01-099-2414
5101B	6625-01-105-3598
5102B with -03 and -05	6625-01-233-7104

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Percent and PPM

Calibrator and meter uncertainty specifications are usually given as either percent or parts per million (ppm). These are interchangeable concepts. We have chosen to use the term "ppm" for the most part, mainly to make the numbers more easily readable by reducing the number of zeros. This table will give you an idea of how they relate:

0.1% = 1000 ppm
0.01% = 100 ppm
0.001% = 10 ppm
0.0001% = 1 ppm

An easy memory aid to use is 0.01% and 100 ppm. Reverse the order of the numbers in 0.01% and it comes out as 100 ppm.

5440B & 5442A

GPIB
IEEE-488

RS-232

NSN 6625-01-226-5448 **5440B**

5440B & 5442A Direct Voltage Calibrators

- Full accuracy over extended temperature range of 10°C
- Completely automatic internal calibration, no mechanical adjustments
- Simplified 5-minute external calibration to traceable standards
- Procedure Storage Module for single button test setup (5440B only)
- Completely programmable through the IEEE-488 interface
- Serial printer output for calibration constants and instrument test results

The 5440B and 5442A are equipped with bright vacuum-fluorescent displays for clear visibility at any viewing angle. Even inexperienced operators find the 5440B and 5442A easy to use because the 40-character, alphanumeric display provided in addition to the numeric output display makes operating instructions and error messages clear and readable in engineering units and English language messages instead of coded numerics. For semi-automated testing, the 5440B allows a complete test sequence of up to 60 steps to be stored in the internal Procedure Storage memory and recorded for later use in the interchangeable, plug-in Procedure Storage Modules. A test sequence is recalled and executed one step at a time with each touch of the NEXT STEP key.

The differences between the 5440B and the 5442A are in the operating features and specifications. The 5440B comes equipped with the Procedure Storage Module capability and boost capability for driving the 5205A Precision Power Amplifier and 5220A Transconductance Amplifier in system applications. The rear output terminals found on the 5440B as a standard feature are available for the 5442A as an option. Both instruments have outstanding accuracy specifications and the capability for operating at full rated accuracy over a temperature range of ±5°C from the calibration temperature, making them well-suited for operation in a production environment as well as in a standards lab. Both instruments are completely programmable via the IEEE-488 interface which is included at no extra cost.

The outstanding accuracy specifications for the 5440B and 5442A are easily maintained in any lab by performing the simple, automatic calibration procedures which store the calibration constants in non-volatile solid-state memory. No hardware adjustments are required. The Fluke 732A Reference Standard combined with the Fluke Direct Volt Maintenance Program and the Fluke 752A Reference Divider, provide the highest accuracy reference standards available for this periodic calibration.

Specifications

Specifications apply to both the 5440B and 5442A unless otherwise noted.
Output Voltage: 0 to 1100V
Output Current: 0 to 60 mA up to 22V, except divided outputs; 0 to 25 mA up to 1100V

5440B:

Output Uncertainty Compared to Calibration Standards, ±5°C

Range	Uncertainty Specification: ±(PPM of Output + Microvolts)	
	30 Days	**90 Days**
0V to 11V	1.5 + 5 µV	2.0 + 5 µV
11V to 22V	1.5 + 8 µV	2.0 + 8 µV
22V to 275V	2.5 + 100 µV	3.5 + 100 µV
275V to 1100V	2.5 + 400 µV	3.5 + 400 µV
Divided Output		
0V to 220 mV	4 + 0.5 µV	5 + 0.5 µV
0.22V to 2.2V	3 + 1 µV	4.5 + 1.0 µV
Range	**180 Days**	**1 Year**
0V to 11V	2.5 + 5 µV	3.5 + 5 µV
11V to 22V	2.5 + 8 µV	3.5 + 8 µV
22V to 275V	4.5 + 100 µV	6.0 + 100 µV
275V to 1100V	4.5 + 400 µV	6.0 + 400 µV
Divided Output		
0V to 220 mV	6.5 + 0.5 µV	10 + 0.5 µV
0.22V to 2.2V	6 + 1.0 µV	8 + 1.0 µV

5442A:

Output Uncertainty Compared to Calibration Standards, ±5°C

Range	Uncertainty Specification: ±(PPM of Output + Microvolts)	
	30 Days	**90 Days**
0V to 11V	2.5 + 5 µV	3.0 + 5 µV
11V to 22V	2.5 + 8 µV	3.0 + 8 µV
22V to 275V	3.0 + 100 µV	3.5 + 100 µV
275V to 1100V	2.5 + 400 µV	3.5 + 400 µV
Divided Output		
0V to 220 mV	6 + 0.5 µV	7 + 0.5 µV
0.22V to 2.2V	4 + 1 µV	6 + 1.0 µV
Range	**180 Days**	**1 Year**
0V to 11V	4.5 + 5 µV	6.5 + 5 µV
11V to 22V	4.5 + 8 µV	6.5 + 8 µV
22V to 275V	5.0 + 100 µV	7.0 + 100 µV
275V to 1100V	4.5 + 400 µV	6.0 + 400 µV
Divided Output		
0V to 220 mV	9 + 0.5 µV	12 + 0.5 µV
0.22V to 2.2V	8 + 1.0 µV	11 + 1.0 µV

Uncertainty of Calibration Standards Compared to National Standards

Range	Uncertainty of Standards
0V to 11V	1.5 ppm
11V to 22V	1.5 ppm
22V to 275V	1.7 ppm
275V to 1100V	2.0 ppm
0V to 220 mV	4.0 ppm
0.22V to 2.2V	2.0 ppm

The output uncertainty compared to national standards for the 5440B and 5442A are defined as the algebraic sum for each range of the output uncertainty compared to calibration standards and the uncertainty of the calibration standards compared to national standards. The specifications for uncertainty of calibration standards listed above are those for the Fluke 732A and Fluke 752A. If other standards are used, the uncertainty of those standards must be substituted.

Output Stability

Specifications apply for initial stabilization of two hours, constant ambient temperature of ±1°C, constant line voltage, constant load, and measurement bandwidth of 0.1 Hz to 1 Hz.

Range	±(PPM of Output + Microvolts)		
	10 Minutes	**24 Hours**	**30 Days***
0V-11V	0.2+2 µV	0.3+3 µV	0.5+3 µV
11V-22V	0.2+3 µV	0.4+4 µV	0.5+4.5 µV
22V-275V	0.3+40 µV	0.3+50 µV	1.0+60 µV
275V-1100V	0.3+200 µV	0.3+200 µV	1.0+300 µV
Divided Output			
0 mV-220 mV	0.5+0.2 µV	0.5+0.2 µV	2+0.3 µV
0.22V-2.2V	0.5+0.2 µV	0.5+0.5 µV	2+0.7 µV

* *For best results, use internal calibration for periods exceeding one day.*

Temperature Coefficient of Output

These specifications apply for ambient temperatures outside the ±5°C range of the uncertainty specifications listed earlier.

Range	±(PPM of Output) Per °C	
	0-10°C	**10-30°C**
0V to 11V	0.15 ppm	0.1 ppm
11V to 22V	0.15 ppm	0.1 ppm
22V to 275V	0.2 ppm	0.2 ppm
275V to 1100V	0.2 ppm	0.2 ppm
Divided Output		
0V to 220 mV	0.5 ppm	0.5 ppm
0.22V to 2.2V	0.5 ppm	0.5 ppm
Range	**30-40°C**	**40-50°C**
0V to 11V	0.4 ppm	1.0 ppm
11V to 22V	0.4 ppm	1.0 ppm
22V to 275V	0.6 ppm	1.5 ppm
275V to 1100V	1.0 ppm	1.5 ppm
Divided Output		
0V to 220 mV	0.5 ppm	0.5 ppm
0.22V to 2.2V	0.5 ppm	0.5 ppm

Linearity

These specifications apply for the ambient temperature range of 15°C to 30°C within ±5°C of the external calibration temperature.

Range	±(PPM of Output + Microvolts)
0 mV to 220 mV	0.5 ppm + 0.2 µV
0.22V to 2.2V	0.7 ppm + 0.3 µV
0V to 11V	0.5 ppm + 1.5 µV
11V to 22V	0.5 ppm
22V to 275V	0.5 ppm + 40 µV
275V to 1100V	1.0 ppm

Resolution

Range	Resolution	Maximum Load or Output Resistance
0V to 11V	1 µV	25 mA
11V to 22V	1 µV	
22V to 275V	10 µV	
275V to 1100V	100 µV	
Divided Output		
0V to 220 mV	0.01 µV	495Ω
0.22V to 2.2V	0.1 µV	450Ω

Output Noise

Range	Bandwidth	
	0.1 Hz to 10 Hz	**10 Hz to 10 kHz**
0 mV to 220 mV	0.1 µV	5 µV
0.22V to 2.2V	0.2 µV	15 µV
0V to 11V	1.5 µV	30 µV
11V to 22V	3.0 µV	50 µV
22V to 275V	35 µV	150 µV
275V to 1100V	100 µV	300 µV

Output Settling Time

Time to settle within a given uncertainty band of final value, for a change in programmed output within a given range.

Range	±Parts Per Million of Change*		
	3 seconds	**5 seconds**	**10 seconds**
0 mV to 220 mV, 0.22V to 2.2V, 0V to 11V, and 11V to 22V	7 ppm	2 ppm	0.5 ppm
22V to 275V 275V to 1100V	–	–	3 ppm

* *Add 0.5 seconds for any change in range up to 22V, 1.0 second for a change from 22V up, and 0.5 seconds for a change from STBY to OPER.*

Line Regulation: Changes less than ±0.1 ppm of range for ±10% change from nominal line voltage

Load Regulation: Less than ±0.1 ppm change of output for change from no-load to full-load or from full-load to no-load for output load impedances greater than 80 ohms

Common Mode Rejection: Greater than 140 dB for frequencies from dc to 400 Hz

Temperature: 0°C to 50°C, operating, except accuracy is degraded above 40°C due to loss of oven regulation; -40°C to +75°C non-operating

Relative Humidity: ≤90% to 30°C except accuracy is degraded above 80%, ≤70% to 40°C, ≤40% to 50°C

Vibration

Frequency	Force	Double Amplitude
5 Hz to 15 Hz	0.7G at 15 Hz	0.06 inches
15 Hz to 25 Hz	1.3G at 25 Hz	0.04 inches
25 Hz to 55 Hz	3G at 55 Hz	0.02 inches

Shock: Eighteen 20G $^{1}/_{2}$-sinewave shocks

Compliance With External Standards: ANSI C39.5 Dec 1980 and IEC 348 Second Edition 1978

EMI/RFI Review Standards: FCC Rules Part 15, Subpart J; European Standard VDE 0871; MIL STD 461B

EMI/RFI Conducted Emissions: FCC Rules Part 15 Class J; European Standard VDE 0871; CISPR.11

Radiated EMI/RFI Emissions: Meets or exceeds all FCC and VDE requirements

Power: 100V, 110V, 115V, 120V ac ±10% or 200V, 220V, 230V, 240V ac ±10%, 50 to 60 Hz, 84W Standby, 145W nominal

Size: 61 cm L x 43 cm W x 24 cm H (24 in x 17 in x 9.4 in)

Weight: 30.2 kg (66.4 lb)

Mounting: Standard 19" EIA relay rack, tapped for attachment of slides; resilient feet provided for bench use

Included: Operator's and Service Manual, serialized and dated Calibration Certificate

5440B: Procedure Storage Module, IEEE-488 Interface, RS-232-C Printer Interface, Boost Interface, Rear Output

5442A: IEEE-488 Interface, RS-232-C Printer Interface

Ordering Information

Models

January 1989 prices

5440B Direct Voltage Calibrator NSN 6625-01-226-5448	$13,650
5442A Direct Voltage Calibrator NSN 6625-01-224-9270	11,550

Accessories (Also see page 485)

5440A-7001 Spare Procedure Storage Module	230
5440A-7002 Low Thermal Copper EMF Plug-In Cables	350
732A DC Reference Standard	3800
732A-000 w/Special Calibration, shipped hot	4040
732A-100 w/Special Calibration and Drift Certification, shipped hot	4245
752A Reference Divider	5190
M08-205-600 $8^{3}/_{4}$" Rack Mount Kit	110
M00-280-610 24" Rack Slide Kit (Requires M08-205-600)	130
5442A-01 Rear Output Option	345

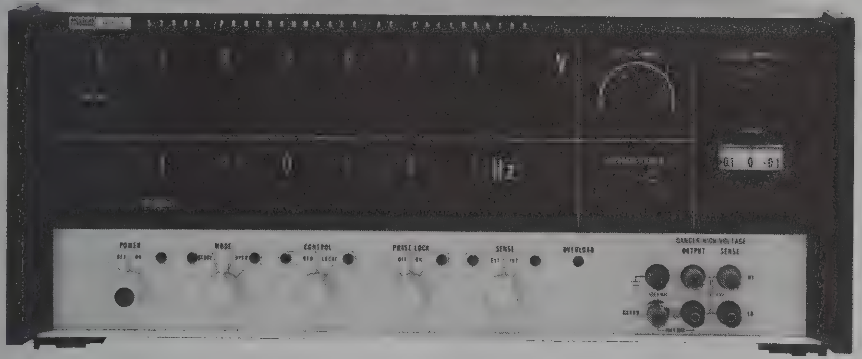
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

5200A

GPIB
IEEE-488



(NSN 6625-01-063-6325) **5200A**

5200A Precision Alternating Voltage Calibrator

- 120 ppm point uncertainty available
- Seven voltage ranges from 1 mV to 1000V
- $6^1/_2$ digit resolution
- Output frequencies from 10 Hz to 1 MHz
- Automated characterized operation available
- GPIB/IEEE-488 system interface available
- Phase-lock input
- Completely guarded
- Short and overload protected

A Proven Performer

The Model 5200A Alternating Voltage Calibrator is a precision high-performance alternating voltage source with proven reliability and exceptional stability and accuracy over a broad frequency range. It is specified over a wide 0°C to 50°C operating range for use in both laboratory and manufacturing environments. Amplitude is controlled in six ranges from 1 mV to 100V. Resolution to 1,199,999 counts yields 20% overrange capability with 1 nanovolt steps on the 1 mV range, up to 0.1 mV steps on the 100V range. Outputs from 100 µV rms to 120V rms are provided, with up to 50 mA load current capability.

An additional 1000V range is included for front panel or remote interface control of a 5205A or 5215A Precision Power Amplifier.

Amplitude error measurement for voltmeter calibration is provided in two ranges, ±3% and ±0.3%. Error measurements can be resolved to 10 ppm.

Five frequency ranges are provided from 100 Hz to 1 MHz, with 119,999 count resolution for 20% overrange capability with 0.01 Hz steps on the 100 Hz range, up to 100 Hz steps on the 1 MHz range.

The oscillator of the 5200A may be phase locked to an external source to produce synchronous signals of precision amplitude and stability. Signal phase is locked within ±1° of phase angle, ±0.05°/kHz, over a ±2% band around the center frequency. This capability is essential for 60 Hz calibration.

A 3V pulse signal is provided for monitoring frequency with an external counter.

A quadrature output signal is provided which leads the fundamental signal phase by 90°. Amplitude varies from 1V to 10V rms, proportional to the fundamental signal output level on any range. This signal is useful for wattmeter calibration, and for research and development tasks that use the 5200A as a precision source.

External sensing may be selected, bringing rated accuracy to the load point bypassing losses in output leads.

Outputs are protected from overload by current limiting. Overload response time is typically 2 microseconds. When an overload is removed output recovers automatically to its previous level.

The 5200A is a fully guarded calibrator. This allows floating operation, and eliminates system ground loop problems. This is especially useful for calibrating non-guarded equipment.

Remote Programming (Opt -01 or -05)

The 5200A is remotely programmable in all functions except Power, Remote/Local, and Vernier Voltage Error. For any programmed amplitude, the output settles to its specified uncertainty within 0.5 seconds for frequencies above 100 Hz, and within 4 seconds for frequencies below 100 Hz. Program status flags are provided to indicate settling time and current limit conditions to the controller.

Either the 5200A-01 Parallel Remote Control Interface or the 5200A-05 GPIB/IEEE-488* System Interface may be installed in the 5200A, for complete remote control of both the 5200A Calibrator and a 5205A or 5215A Power Amplifier.

The 5200A-01 Parallel Remote Control Interface provides excellent isolation between external system logic and internal calibrator circuitry. This isolation is typically $10^9\Omega$ in parallel with 30 pf capacitance. This effectively attenuates external logic and ground noise better than 100:1 at 10 MHz.

Command data is segmented into 4-bit groups that can be programmed separately or simultaneously. Command data is stored both inside and outside the guard.

5200A-01 programming levels are compatible with TTL logic, and with contact closure:
Standard levels:
Logic 1 or true = 0 to +0.4 dV
Logic 0 or false = +2.8V to +5.0 dV
(For inverted logic levels, also order option 5200A-03.)

The 5200A-01 includes both standard and blank address matrix cards, and a mating connector.

The 5200A-05 IEEE-488 System Interface incorporates subsets SH1, AH1, T6, TEO, L4, LEO, SR1, RLO, PPO, DC2, and DTO of IEEE Standard 488-1980. The 5200A-05 may be addressed for a 2-byte status response or serial polled for a 1-byte response. Status information includes Remote/Local, Standby/Operate, limits, settling time, and out-of-range instruction.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Automated Characterized Operation

The established excellent stability and performance history of the 5200A Alternating Voltage Calibrator offers an opportunity for further reducing calibration uncertainty while greatly simplifying use.

Characterization is a process of measuring a particular calibrator's uncertainties at selected points using traceable transfer standards and recording those uncertainties in a table. When the selected points are used, the portion of these uncertainties not due to the transfer standards or to the characterization process can then be added to (or subtracted from) the calibrator setting. In practice, this significantly reduces calibrator uncertainty.

Mathematical interpolation methods are used for points other than those selected for characterization. While this yields a significant improvement in uncertainty specifications, it can be complex and time consuming when done manually.

Option 5200A-800 is a software package that uses a Fluke 1722A or 1752A Instrument Controller to operate a 5200A Alternating Voltage Calibrator and a 5205A or 5215A Precision Power Amplifier. This software makes use of a stored characterization table and automatically interpolates for voltages and frequencies selected between characterization points.

The 5200A-800 controls all calibrator functions in a simplified manner with the touch-sensitive display of the 1722A or 1752A.

Calibration

The 5200A is originally calibrated at the factory by instrumentation traceable to the U.S. National Bureau of Standards. Periodic traceable recalibration service is available through Fluke Technical Service Centers and Sales Representatives worldwide.

Fluke also offers 5200A characterization service as well as 540B characterization for customers doing their own 5200A characterization. The table of correction factors is supplied in written form, and on a disk compatible with the 5200A-800.

Specifications

Technical Specifications

Amplitude Uncertainty

Specified for 180 days. Characterized uncertainty requires optional 5200A-900 characterization. Both specifications are valid when operating in an ambient temperature between 18°C and 28°C after a 1-hour warmup.

Basic Instrument Absolute Uncertainty [1]			Characterized Uncertainty [2]		
Voltage Ranges	Frequency Hz	±(ppm setting + µV)	Frequency Hz	±(ppm setting + µV) Relative	±(ppm setting + µV) Absolute
1 mV [3] 10 mV	10-30	1000+10			
	30-20K	200+10			
	20K-100K	500+20			
	100K-1M	3300+30			
100 mV	10-30	1000+10	50-100	130+10	150+10
	30-20K	200+10	100-20K	125+10	145+10
	20K-100K	500+20	20K-50K	180+20	250+20
	100K-1M	3300+30	50K-100K	200+20	470+20
		±(ppm setting + ppm range)		±(ppm setting+ppm range)	
1V 10V 100V	10-30	1000+50	50-100	130+20	150+20
	30-20K	200+20	100-20K	125+15	145+15
	20K-100K	500+50	20K-50K	180+20	250+20
	100K-1M	3300+30	50K-100K	300+30	470+30
1000V [4]	10-30	1200+50	50-100	190+20	210+20
	30-20k	400+40	100-10k	180+20	180+20
	20k-50k	800+50	10k-20k	200+20	200+20
	50k-100k	1000+100	20k-50k	310+30	310+30

Notes:

1. Valid for 180 days, between 18°C and 28°C, after 1-hour warm-up

2. 180 days. Requires 5200A-900

3. On 1 mV range, specification applies for measuring instruments with less than 2 MHz bandwidth.

4. Output is through a 5205A or 5215A Power Amplifier

Characterized-Point Absolute Uncertainty, ±ppm*									
Voltage	Frequency, Hz								
	50	100	200	1k	2k	10k	20k	50k	100k
0.5	125	125	–	125	–	125	–	210	450
1	120	120	120	120	120	120	120	200	450
3	130	130		130	130	130		220	450
10	120	120	120	120	120	120	120	200	450
30	130	130		130	–	130	–	220	450
100	120	120	120	120	120	120	120	200	450
300	190	190	–	190	–	190	–	630	–
1000**	180	180	180	180	180	180	200	610	–

** 180 days. Requires 5200A-900. Traceable to U.S. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques*

*** Output is through a 5205A or 5215A Power Amplifier.*

Voltage Resolution

Range	Voltage Settings	Resolution
1 mV	0.100000 mV to 1.199999 mV	1 nV
10 mV	1.00000 mV to 11.99999 mV	10 nV
100 mV	10.0000 mV to 119.9999 mV	100 nV
1V	0.100000V to 1.199999V	1 µV
10V	1.00000V to 11.99999V	10 µV
100V	10.0000V to 119.9999V	100 µV
1000*	100.000V to 1199.999V	1 mV

**Output is through a 5205A or 5215A Power Amplifier*

Stability

Voltage Ranges	Frequency Hz	Stability [1] (ppm setting + ppm range) [2]	
		10 Minutes	180 Days
1 mV 10 mV	10 - 30	70 + 40	300 + 60
	30 - 20k	70 + 3 [3]	100 + 30
	20k - 100k	70 + 3	130 + 40
100 mV	10 - 30	70 + 40	300 + 60
	30 - 1k	70 + 3 [3]	70 + 40
	1k - 20k	70 + 3	100 + 30
	20k - 50k	70 + 3	120 + 50
	50k - 100k	70 + 3	100 + 130
1V 10V 100V	10 - 30	70 + 40	200 + 20
	30 - 20k	35 + 5 [3]	45 + 5
	20k - 50k	55 + 5	65 + 5
	50k - 100k	70 + 3	220 + 20
1000V [4]	10 - 100	0 + 50	200 + 0
	100 - 20k	70 + 5	200 + 0
	20k - 100k	70 + 5	400 + 0

Notes:

1. Constant line, load, and temperature.

2. Total peak to peak random change in rms value.

3. For frequencies below 50 Hz, floor is 40 ppm of range.

4. Output is through a 5205A or 5215A Power Amplifier.

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C; for the 1000V range add ±(0.03 x uncertainty) per °C

Maximum Load: 1 mV, 10 mV, 100 mV ranges: minimum 6000Ω load impedance; 1V,* 10V, 100V ranges: maximum load current 50 mA; 1000V range: maximum load current 200 mA

**Minimum load impedance 50Ω above 0.1 MHz*

Voltage Error Control: Switch selectable OFF, on two ranges: 0 to ±0.3% with 10 ppm resolution; 0 to ±3% with 100 ppm resolution

Settling Time

Frequency Hz	Settling Time,* Seconds
10 - 30	4 to 15
30 - 100	4
100 - 400	2
400 - 1M	1**

** To within 100 ppm of change*

*** Typically less than 0.5 second, except frequency range changes*

External Sense: Switch selectable, internal or external, available on 1V, 10V, and 100V ranges.* Output rises to less than 2.0V rms above selected level when sense lines are disconnected in external sense mode

** Output impedance on 1 mV, 10 mV, and 100 mV ranges is less than 1.5Ω in series with 15 µH*

Frequency Performance*

Range	Frequency Settings	Resolution Hz**	Uncertainty ±(% of input + % of Range)
100 Hz	10.00 Hz to 119.99 Hz	0.01	1.0 + 0.1
1 kHz	.1000 kHz to 1.1999 kHz	0.1	
10 kHz	1.000 kHz to 11.999 kHz	1	
100 kHz	10.00 kHz to 119.99 kHz	10	
1 MHz	.1000 MHz to 1.999 MHz	100	3.0 + 0.3

** 180 days, 18°C to 28°C, after 1-hour warm-up*

***100 ppm of range*

Total Harmonic Distortion and Line-Related Noise*

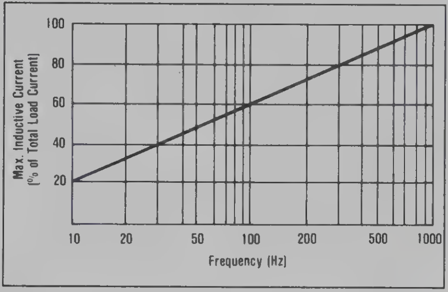
Frequency Hz	±(% of setting + µV rms)
10k - 100k**	0.04% + 10
100k - 500k	0.3% + 30
500k - 1M	1.0% + 30

** Bandwidth 10 Hz to 10 MHz, and less than 15 mA output current except 1000V range. See 5205A or 5215A specifications*

*** 1V range is ±0.08% from 10 Hz to 15 Hz*

Maximum Capacitive Load: 1000 pF on 1 mV-100V ranges, 1500 pF on 1000V range

Maximum Inductive Load Current: (Except 1000V range)



Phase Lock Input: 1V to 10V rms, useable down to 100 mV rms

Phase Lock Accuracy: ±3° below 30 Hz, and ±(1° + 0.05° per kHz) over a ±2% band around center frequency

Quadrature Output:

Amplitude: 1V to 10V rms, ±10%, proportional to selected output voltage

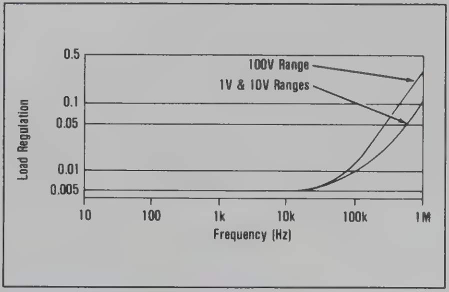
Phase: 10 Hz-40 Hz, 90° ±3°; 40 Hz to 1.2 MHz, 90° ±(1° + 0.03° per kHz)

Minimum Load: 3 kΩ impedance

Current Limit: Typical transition time, 2 µs. Recovery within specified settling time

Volt-Hertz Product: Output voltage x frequency $\leq 10^7$. Full 120V rms output is maintained up to 83.33 kHz. Maximum output voltage at 1.2 MHz is 8.33V rms

Load Regulation: 50 ppm of range, no load to full load, up to 10 kHz



General Specifications

Maximum Isolation Voltages: (dc or peak ac) 500V, GUARD to chassis; 100V, LO to GUARD

Temperature: 0°C to +50°C operating, -40°C to +75°C storage

Input Power: Switch selectable, 100V, 115V, 200V, 230V ac, 100W

Size: 17.8 cm H x 43.2 cm W x 53.3 cm D (7 in x 17 in x 22.5 in)

Weight: 24.1 kg (53 lb)

Includes: Instruction manual, mating connectors, power cord, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

5200A Precision Alternating Voltage Calibrator	$10,950
5205A AC/DC Precision Power Amplifier	10,450
5215A Precision Power Amplifier	9750
5200A/5215A Precision Alternating Voltage Calibration System	20,700
1722A Instrument Controller	6990

Options (for 5200A)

-01* Parallel Remote Control Interface	1360
-03 Logic Level Inversion (for 5200A-01)	225
-05** IEEE-488 System Bus Interface	2100
-800*** Automated Characterized Operation Software	550
-900 Characterization of New-Purchase 5200A and 5215A	895
-902 Characterization of New-Purchase 5200A	730

** Cannot be used with 5200A-05*

*** Cannot be used with 5200A-01*

**** Requires 1722A, 1752A or 1720A, and 5200A-900 or 5200A-902*

Accessories (Also see page 485)

M07-205-600 Rack Mount Kit for 5200A	110
M10-205-600 Rack Mount Kit for 5215A	110
M00-280-610 24" Rack Slides for rack adapter	130
Y1790 Rack Mount Kit w/24" Slides for 1722A	195
5200A-7015K Extender Board Kit	315

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-5200A Repair (w/calibration)	479
SC1-5200A Repair (cal w/in or out data)	554
SC1-5200A Repair (cal w/in & out data)	629
SC2-5200A Cal	348
SC2-5200A Cal (w/in or out data)	498
SC2-5200A Cal (w/in & out data)	648
SC1-5215A Repair (w/calibration)	772
SC1-5215A Repair (cal w/in or out data	847
SC1-5215A Repair (cal w/in & out data)	922
SC2-5215A Cal	462
SC2-5215A Cal (w/in or out data)	612
SC2-5215A Cal (w/in & out data)	762

5450A

GPIB
IEEE-488

NSN 6625-01-249-6325 **5450A**

5450A Resistance Calibrator

- 17 standard resistors in one enclosure
- Decade values from 1.0Ω to 100 MΩ
- 1.9 multiples from 1.9Ω to 19 MΩ
- True passive resistors for low noise and offset
- Midband accuracy of 8 ppm over 18°C to 28°C
- 4-wire or 2-wire operation
- Easy data entry for test lead compensation
- Automatic meter error calculation
- IEEE-488 programmable

The 5450A Resistance Calibrator is designed to verify the resistance-measuring accuracy of precision multimeters, either manually or as part of an automated calibration process. It complements the 5440A and 5442A Direct Voltage Calibrators.

The 5450A provides cardinal point resistance values in decade steps from 1Ω through 100 MΩ and decade steps from 1.9Ω through 19 MΩ.

Each resistor differs from its nominal value by no more than 0.1%. But the precise value of each is known with a much higher degree of certainty. The known value of each is stored internally and used for calibration purposes. Each value displayed has 1 ppm resolution.

Four-wire connections eliminate the effects of lead resistance or, for 2-wire operation, you may measure and store the lead resistance value and automatically subtract it from the value of each resistor. Connections to the instrument being calibrated may be made to the front panel terminals or to special rear panel binding posts that contribute very low thermal offset voltage errors.

Calibrating the 5450A consists of storing the right values of each resistor. Recalibration can be accomplished without removing the instrument covers, and may even be done remotely over the IEEE-488 bus. A rear panel switch insures integrity of calibration.

The 5450A displays the precise value of each selected resistor and can show the error of the instrument being calibrated either in percent or in parts per million. All functions that can be controlled from the front panel may be controlled remotely via an IEEE-488 bus. No options are required to make the 5450A compatible with the bus; interface circuits are built in.

Specifications

The analog specifications apply when the 5450A is calibrated using a 10 kΩ standard resistor, the absolute value of which is known within ±2 ppm or better and using the ratio calibration method for calibrating resistor values from 10Ω through 100 MΩ. The 1.0Ω and 1.9Ω value must be calibrated by comparison to a 1Ω standard whose absolute value is known within ±5 ppm.

General Specifications

Temperature: 0°C to 50°C, operating
Relative Humidity: ≤70% for rated accuracy
Power: 100, 120, 220, or 240 aV ±10%, 50 to 60 Hz ±5%, ≤50W
Size: 8.9 cm H x 43.2 cm W x 55.4 cm L (3.5 in x 17 in x 21.8 in)
Weight: 9.3 kg (20.4 lb)
Included: Instruction manual, line cord, serialized and dated calibration certificate

Ordering Information

Model

January 1989 prices

5450A Resistance Calibrator	$4750

Accessories (Also see page 485)

Y8021 1m Cable for IEEE-488 bus	130
Y8022 2m Cable for IEEE-488 bus	145
Y8023 4m Cable for IEEE-488 bus	155
M00-260-610* 18" Rack Slides	130
M00-270-610* 20" Rack Slides	130
M00-280-610* 24" Rack Slides	130
Y8599 3" Rack Adapter	70
Y8598 3" Rack Adapter with 22"Slides	130

**Requires Y8599*

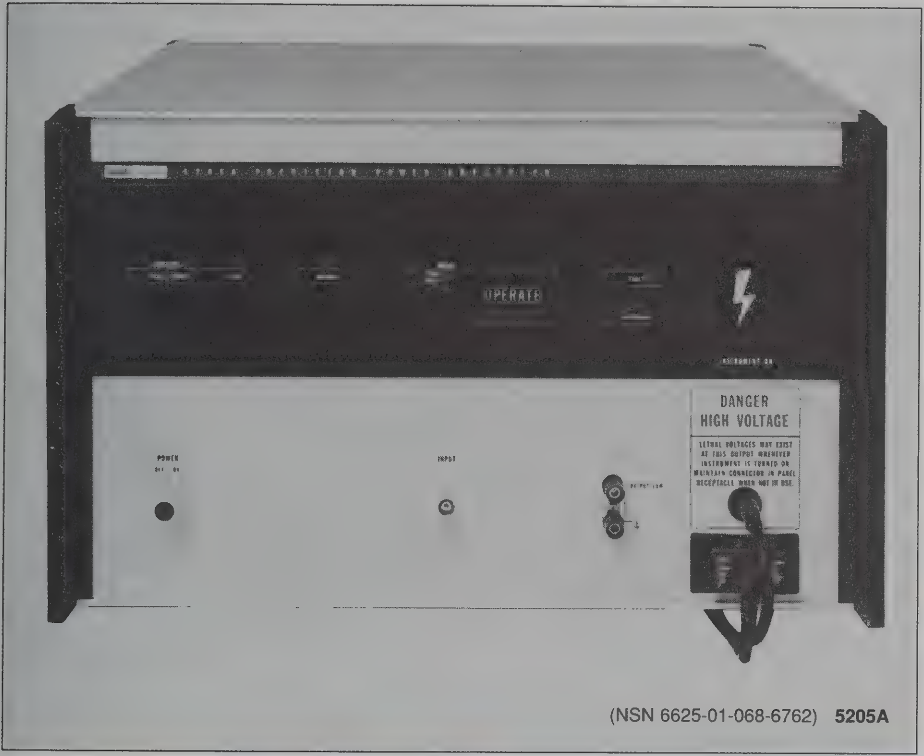
Analog Specifications

Uncertainty, For Rated Current, 4-Wire Connections

Nominal Resistance	Absolute Uncertainty (±ppm unless indicated)				Normal Current Ranges	
	23°C±1°C, ≤70% RH		23°C ±5°C, ≤70% RH			
	24 Hours	90 Days	90 Days	1 Year	Lower	Upper
Short	.1mΩ	.1mΩ	.1mΩ	.1mΩ	10 mA	500 mA
1Ω	50	62	75	110	10 mA	100 mA
1.9Ω	40	52	65	100	10 mA	75 mA
10Ω	18	20.5	25	33	10 mA	25 mA
19Ω	16	18.5	23	31	10 mA	25 mA
100Ω	7.5	9	11	16	10 mA	15 mA
190Ω	7	8.5	10.5	15.5	10 mA	15 mA
1 kΩ	5.5	7	8.5	13.5	700 µA	2.5 mA
1.9 kΩ	5	6.5	8	13	500 µA	2.5 mA
10 kΩ	5	6.5	8	13	50 µA	1 mA
19 kΩ	4.5	6	7.5	12.5	50 µA	1 mA
100 kΩ	6	7.5	9	14	5 µA	250 µA
190 kΩ	5.5	7	8.5	13.5	5 µA	250 µA
1 MΩ	7.5	10	11.5	19	5 µA	50 µA
1.9 MΩ	7.7	10	11.5	19	5 µA	25 µA
10 MΩ	16	24	26	50	.5 µA	5 µA
19 MΩ	20	28	30	56	.25 µA	2.5 µA
100 MΩ	65	90	120	200	.05 µA	.5 µA

** Relative to National Standards such as U.S. Bureau of Standards*

5205A



(NSN 6625-01-068-6762) **5205A**

5205A Precision Power Amplifier

- Extends range of 5700A, 5100 Series B, 5200A, 5440B, or 5442A Calibrators
- Output voltages to 1100V rms, ±1500V dc
- Maximum output power 220 watts
- DC to 100 kHz, typical upper limit 120 kHz
- 420 ppm midband amplitude uncertainty at 1000V rms
- 200 ppm midband six-month stability
- Fully programmable

The 5205A Precision Power Amplifier is a dc coupled programmable inverting amplifer with a fixed gain of 100. Designed as a precision calibration amplifier, the 5205A is also useful as a general-purpose amplifier for a wide range of waveforms from dc to 100 kHz. Alternating voltage output level is specified to 1100V at up to 200 mA, with a typical upper limit of 1200V before automatically tripping into standby mode. Direct voltage output level is specified to ±1500V at up to 100 mA, with a typical upper trip limit of 1600V.

The 5205A includes automatic-overload sensing and recovery. Upon sensing an excessive slew rate or frequency of the input signal, or a momentary output overload, output is returned to zero within 2 microseconds and held there for 6 milliseconds or until the fault is corrected. When a steady overload, shorted output, or excessive input drive level is detected, the 5205A trips and locks into standby mode and displays a fault indicator.

A calibrator interface is standard, including an independent input signal line. When used with a 5100 Series B, 5200A, 5440B, or 5442A Calibrator, the 5205A is controlled by the calibrator as an extension of its capabilities.

A remote control interface is also standard, and independent of the calibrator interface. This allows remote switching between the calibrator and an alternate signal input source through a front panel BNC connector.

Amplifier features of the 5205A include a gain uncertainty of as little as 0.04%, and a slew rate as high as 800 volts per microsecond.

The 5205A includes a 1-meter output cable with a protective shrouded connector. When used with a 5200A AC Calibrator, remote sensing is brought to this connection point for maximum accuracy. An insulated receptacle is provided on the front panel for safe storage of the output connector when not in use. Option 5205-07, for system applications, moves this cable and the BNC amplifier input connector to the rear panel.

All calibration adjustments and lamp replacements can be performed without exposure to high voltage. The output amplifier and all of the printed circuit modules are easily removed for repair or exchange.

Calibration and Characterization

The 5205A is calibrated at the Fluke manufacturing facility by instrumentation traceable to the U.S. National Bureau of Standards. When ordered with a 5200A AC Calibrator, 5200A-900 characterization may be ordered including simultaneous characterization of the 5205A at points compatible with 5200A-800 software. See the 5200A Alternating Voltage Calibrator for more information.

Specifications

Calibrator Mode

Amplitude Uncertainty With 5100 Series B Calibrator

Absolute Uncertainty*	
Frequency Hz	**±(ppm setting + mV)**
dc	700 + 30
50 - 10k	800 + 100
10k - 50k	1200 + 150

* *Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 20°C to 30°C, after 1-hour warm-up*

Amplitude Uncertainty With 5200A Calibrator

Basic Instrument Absolute Uncertainty*		Characterized Uncertainty**		
Freq Hz	±(ppm setting + ppm range)	Freq Hz	±(ppm setting + ppm range)	
			Relative	Absolute
10-30	1200+50	50-100	190+20	210+20
30-20k	400+20	100-10k	180+20	200+20
20k-50k	800+50	10k-20k	200+20	220+20
50k-100k	1000+100	20k-50k	310+30	630+30

* *Includes transfer standards, dc reference source, and allowances for techniques. 90 days, 18°C to 28°C, after 1-hour warm-up*

** *180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

5205A

Characterized-Point Absolute Uncertainty With 5200A:* ±ppm

Frequency, Hz							
50	100	200	1k	2k	10k	20k	50k
180	180	180	180	180	180	200	610

Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900

Amplitude Uncertainty With 5700A,5440B, or 5442A Calibrator: Use amplifier-mode gain uncertainty specifications
Output Voltage Range: 100V to 1099.999V, ±dV or rms aV
Output Voltage Resolution: 1 mV with 5200A, 5440B, or 5442A; 10 mV with 5100 Series B
Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C

Stability With 5100 Series B, 5440B, or 5442A Calibrator: Use amplifier-mode gain stability specifications

Stability With 5200A Calibrator

Frequency Hz	10 Minutes	24 Hours	6 Months
	±(ppm setting + ppm range)		
10-100	0 + 50	100 + 0	200 + 0
100-20k	70 + 5	100 + 0	200 + 0
20k-100k	70 + 5	200 + 0	400 + 0

Constant line, load, and temperature, total peak to peak random change in rms value

Amplifier Mode

Maximum Output Voltage: 1100V rms aV, ±1500V dV
Typical Overload Trip Voltage: 1200V rms aV, ±1600V dV
Maximum Input Voltage: 50V, dV or rms aV (without damage)
Frequency Range: 0 to 100 kHz
Typical Upper Trip Frequency: 120 kHz
Gain: X100, inverting

Gain Uncertainty

Maximum Load	DC to 20 kHz	20 kHz to 100 kHz
500Ω, 100 pF	±0.05%	±0.2%
5000Ω, 100 pF	±0.05%*	±0.15%
1 MΩ, 200 pF	±0.05%	±0.2%
1 MΩ, 500 pF	±0.06%	±0.4%
1 MΩ, 1000 pF	±0.08%	±0.8%
1 MΩ, 1500 pF	±0.1%	±1.2%

*±0.04%, dc to 10 kHz

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add per °C below 18°C or above 28°C: dc to 20 kHz: ±(0.03 x uncertainty); 20 kHz to 100 kHz: ±(0.06 x uncertainty)

Gain Stability

Frequency Range	Max Capacitive Load	24 Hours	6 Months
dc to 20 kHz	1500 pF	0.02%	0.06%
20 to 100 kHz	100 pF	0.08%	0.2%
20 to 100 kHz	1500 pF	0.4%	0.8%

Maximum Slew Rates:*

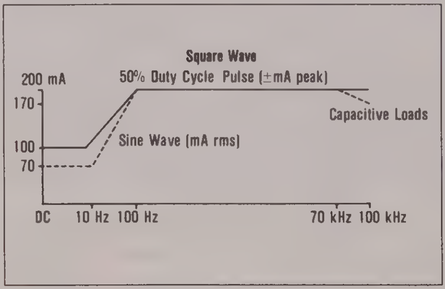
Maximum Load	Max Input Slew Rates	Max Output Slew Rates
200 mA Resistive	8.0V/µs	800V/µs
100 pF Capacitive	8.0V/µs	800V/µs
200 pF Capacitive	5.0V/µs	500V/µs
500 pF Capacitive	3.0V/µs	300V/µs
1000 pF Capacitive	2.0V/µs	200V/µs
1500 pF Capacitive	1.0V/µs	100V/µs

** Greater than 1000V output swing. Higher rates may trigger protection circuitry.*

Maximum Output Overshoot: Less than 4% of amplitude, with less than maximum input slew rate, and with greater than 1000V output swing
Maximum Isolation Voltage: Output common may be floated up to ±10V dc or rms ac from chassis to reduce common mode errors
Input Impedance: 10 kΩ in parallel with less than 120 pF
Input Connector: BNC, located on front panel. (Located on rear panel with Option -07)
Maximum Input Voltage: 50V dV or rms aV
Maximum Input Bias Current: 100 nA

General Specifications

Maximum Load Current: Bipolar symmetrical waveforms



Unipolar Rectangular Waveform:* ±200 mA peak with pulse width less than 5 msec; period greater than 10 msec.
Linearly derating to: ±100 mA peak with pulse width greater than 50 msec; period less than 100 msec

** Referenced to zero volts. Under all circumstances, output current capability is at least ±100 mA peak*

Maximum Capacitive Load: 1500 pF, not to exceed rated load current. (Example: maximum capacitive load at 1000V, 100 kHz is 270 pF
DC Offset Voltage: ±10 mV at the output*

**90 days, 18°C to 28°C, after 1-hour warm-up*

Total Harmonic Distortion:* Resistive loads greater than 1500Ω or capacitive loads less than 1000 pF

10 Hz to 20 kHz	0.05% of setting
20 kHz to 50 kHz	0.07% of setting
50 kHz to 100 kHz	0.1% of setting

Resistive loads less than 1500Ω or capacitive loads greater than 1000 pF

10 Hz to 10 kHz	0.05% of setting
10 kHz to 20 kHz	0.1% of setting
20 kHz to 50 kHz	0.17% of setting
50 kHz to 100 kHz	0.25% of setting

**Bandwidth 10 Hz to 1 MHz*

Overload Protection: Limit protection against input noise spikes, momentary output over loads, excessive input slew rate, and excessive input frequency. Trip protection against input overdrive, steady overloads, and short circuit.
Random Noise: Less than 100 mV rms, 1 MHz bandwidth
Line-Related Noise: Less than 50 mV rms
Line Regulation: ±10 ppm of setting for 10% change in line voltage
Input Power: 100V, 115V, 200V, 230V ac, ±10%, internal jumper selected, 50 Hz to 60 Hz, 1800 VA at full load. Receptacle on rear panel for calibrator power
Size: 26.7 cm H x 43.2 cm W x 62.7 cm D (10.5 in H x 17 in W x 24.7 in D)
Weight: 54.5 kg (120 lb)
Included: Instruction Manual, interface cable to 5200A, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

5205A Precision Power Amplifier	$10,450
5205A-07 With Rear Input/Output	10,470

Accessories (Also see page 485)

Y5000 Interface Buffer for 5100 Series ..	600
Y5001 Interface Cable for 5100 Series, 5440B, or 5442A	275
M10-205-600 Rack Mount Kit for 5205A	110
M00-280-610 24" Rack Slides for rack adapter	130

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

POWER
OFF ON
OUTPUT LOW
INSTRUMENT ON
DANGER
HIGH VOLTAGE
LETHAL VOLTAGES MAY EXIST AT THIS OUTPUT WHENEVER INSTRUMENT IS TURNED ON. MAINTAIN CONNECTOR IN PANEL RECEPTACLE WHEN NOT IN USE.

NSN 5895-01-088-8715 **5215A**

5215A Precision Power Amplifier

- Designed for use with 5700A, 5200A, or 5100B Calibrators
- Output voltages to 1100V rms
- Maximum output power 220 watts
- 10 Hz to 100 kHz, typical upper limit 120 kHz
- 420 ppm midband amplitude uncertainty at 1000V rms
- 200 ppm midband six-month stability
- Fully programmable
- Short and overload protected

The 5215A Precision Power Amplifier is an ac coupled programmable inverting amplifer with a fixed gain of 100. Output level is specified to 1100V at up to 200 mA, with a typical upper limit of 1200V before automatically tripping into standby mode.

The 5215A includes automatic-overload sensing and recovery. Upon sensing an excessive slew rate or frequency of the input signal, or a momentary output overload, output is returned to zero within 2 microseconds and held there for 6 milliseconds or until the fault is corrected. When a steady overload, shorted output, or excessive input drive level is detected, the 5215A trips and locks into standby mode and displays a fault indicator.

An interface for a 5200A Alternating Voltage Calibrator is standard, allowing the 5215A to be controlled by the calibrator as an extension of its capabilities.

The 5215A includes a 1-meter output cable with a protective shrouded connector. Remote sensing is brought to this connection point for maximum accuracy. An insulated receptacle is provided on the front panel for safe storage of the output connector when not in use. Option 5215-07, for system applications, moves this cable to the rear panel.

All calibration adjustments and lamp replacements can be performed without exposure to high voltage. The output amplifier and all of the printed circuit modules are easily removed for repair or exchange.

Calibration and Characterization

The 5215A is calibrated at the Fluke manufacturing facility by instrumentation traceable to the U.S. National Bureau of Standards. When ordered with a 5200A AC Calibrator, 5200A-900 characterization may be ordered including simultaneous characterization of the 5215A at points compatible with 5200A-800 software. See the 5200A Alternating Voltage Calibrator for more information.

Specifications

Amplitude Uncertainty With 5200A Calibrator

Basic Instrument Absolute Uncertainty*		Characterized Uncertainty**		
Freq Hz	±(ppm setting + ppm range)	Freq Hz	±(ppm setting + ppm range)	
			Relative	Absolute
10-30	1200+50	50-100	190+20	210+20
30-20k	400+20	100-10k	180+20	200+20
20k-50k	800+50	10k-20k	200+20	220+20
50k-100k	1000+100	20k-50k	310+30	630+30

** Includes transfer standards, dc reference source, and allowances for techniques. 90 days, 18°C to 28°C, after 1-hour warm-up*

*** 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

Characterized-Point Absolute Uncertainty:* ±ppm

Frequency, Hz							
50	100	200	1k	2k	10k	20k	50k
180	180	180	180	180	180	200	610

**Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

Output Voltage Range: 100V to 1099.999Vrms
Output Voltage Resolution: 1 mV with 5200A; 10 mV with 5100 Series, ac output only
Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C

Stability

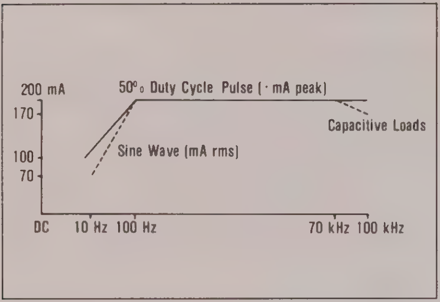
Frequency Hz	10 Minutes	24 Hours	6 Months
	±(ppm setting + ppm range)		
10-100	0 + 50	100 + 0	200 + 0
100-20k	70 + 5	100 + 0	200 + 0
20k-100k	70 + 5	200 + 0	400 + 0

**Constant line, load, and temperature, total peak to peak random change in rms value*

5215A

Maximum Isolation Voltage: Output common may be floated up to ±10V dc or rms ac from chassis to reduce common mode errors

Maximum Load Current:



Maximum Capacitive Load: 1500 pF, not to exceed rated load current. (Example: maximum capacitive load at 1000V, 100 kHz is 270 pF

DC Offset Voltage: ±10 mV at the output*

**90 days, 18°C to 28°C, after 1-hour warm-up*

Total Harmonic Distortion:* Resistive loads greater than 1500Ω or capacitive loads less than 1000 pF

10 Hz to 20 kHz	0.05% of setting
20 kHz to 50 kHz	0.07% of setting
50 kHz to 100 kHz	0.1% of setting

Resistive loads less than 1500Ω or capacitive loads greater than 1000 pF

10 Hz to 10 kHz	0.05% of setting
10 kHz to 20 kHz	0.1% of setting
20 kHz to 50 kHz	0.17% of setting
50 kHz to 100 kHz	0.25% of setting

**Bandwidth 10 Hz to 1 MHz*

Overload Protection: Limit protection against input noise spikes, momentary output over loads, excessive input slew rate, and excessive input frequency. Trip protection against input overdrive, steady overloads, and short circuit.

Random Noise: Less than 50 mV rms

Line Regulation: ±10 ppm of setting for 10% change in line voltage

Input Power: 100V, 115V, 200V, 230V ac, ±10%, internal jumper selected, 50 Hz to 60 Hz, 1800 VA at full load. Receptacle on rear panel for calibrator power

Size: 26.7 cm H x 43.2 cm W x 62.7 cm D (10.5 in H x 17 in W x 24.7 in D)

Weight: 54.5 kg (120 lb)

Included: Instruction Manual, interface cable to 5200A, power cords, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

5215A Precision Power Amplifier	$9750
5215A-07 With Rear Output	9770

Accessories (Also see page 485)

M10-205-600 Rack Mount Kit for 5205A	110
M00-280-610 24" Rack Slides for rack adapter	130

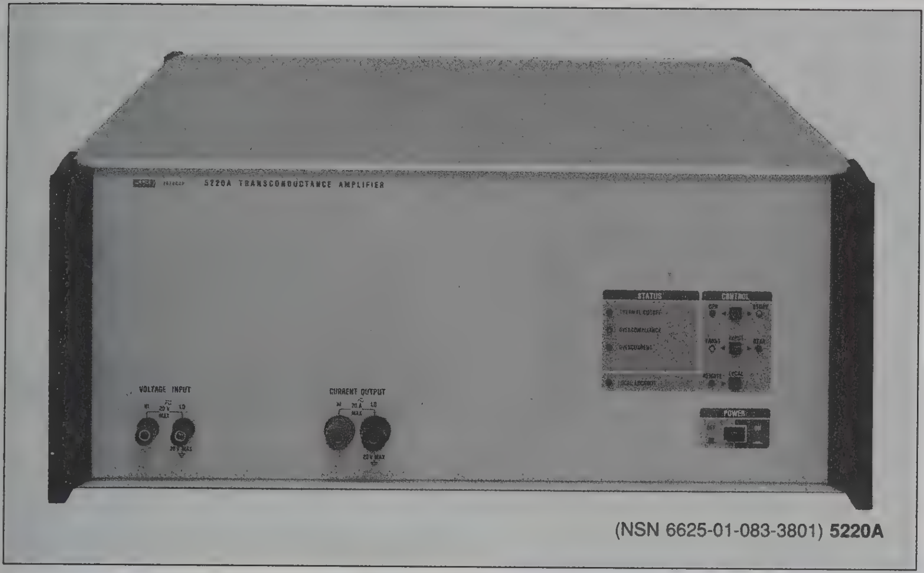
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-5215A Repair (w/calibration)	772
SC1-5215A Repair (cal w/in or out data)	847
SC1-5215A Repair (cal w/in and out data)	922
SC2-5215A Cal	462
SC2-5215A Cal (w/in or out data)	612
SC2-5215A Cal (w/in & out data)	762



(NSN 6625-01-083-3801) **5220A**

5220A Transconductance Amplifier

- 20 amps output dc or rms ac
- 0.025% basic dc accuracy
- Over-voltage and over-current protection
- Over-temperature protection
- May be programmed through the 5100 Series B

The 5220A Transconductance Amplifier lets you calibrate alternating or direct current meters and shunts and the current functions of digital multimeters that measure up to 20A. A known input voltage of 1 to 20 volts produces a known output current of 1 to 20A.

The 5220A is designed to be controlled by the 5100 Series B Calibrators but may be driven by another voltage source such as the 5200A. When used with a 5100 Series B, the current range of those instruments is extended by a factor of 10 to 1. Options are available for the 5100 Series B that make the system IEEE-488 and RS-232-C compatible.

Built-in Protection

Protection is designed in to eliminate problems caused by excessive inputs, open inputs, and overcompliance. Indicators on the front panel tell the user about any of these conditions. Automatic shut down occurs should the internal temperature rise excessively.

The Y5000 Interface/Buffer

Drive voltage to the 5220A may be introduced through the front panel or the rear panel. The connector on the rear, however, allows the 5220A to work with a 5100B (or 5101B) Calibrator through an Interface/Buffer (Y5000) and cable that attaches to the rear panels.

With the Y5000 Interface/Buffer, the two instruments operate as one integrated calibration system with all the advantages of single control-point calibration; automatic error calculation, entry limit protection, etc.

A single Y5000 Interface/Buffer may be used to control and operate both a 5220A Transconductance Amplifier and a 5205A Power Amplifier from a 5100 Series Calibrator.

Specifications

The specifications below apply for 180 days for instruments operated between 20°C and 30°C in a relative humidity of 70% or less.

Transconductance: 1 siemens (1 ampere per volt)

Output Range: 0 to 20A dc or rms ac (28.3A peak)

Maximum Compliance Voltage: ≥±4V dc, or 3V rms ac (4.25V peak)

DC Accuracy: ±(0.025% of output +1 mA)

AC Accuracy: ±(0.05% of output +1 mA) from 30 Hz to 1 kHz, and ±(0.05% of output +1 mA) x f from 1 kHz to 5 kHz, where f = frequency in kHz

Short Term DC Stability: Output changes less than ±(0.005% + 200 µA) in 10 minutes, with constant line, load, and temperature

Short Term AC Stability: Output changes less than ±(0.01% + 500 µA) in 10 minutes, with constant line, load, and temperature

Harmonic Distortion and Noise: ±(0.05% of output ±1 mA) over frequency range of 30 Hz to 1 kHz and measured with a noise bandwidth of 300 kHz, ±0.05% of output +1 mA) x f from 1 kHz to 5 kHz, where f = frequency in kHz

Temperature Coefficient: ±(0.0025% of output +100 µA) per degree C, above 30°C or below 20°C

Transient Recovery: Output will settle to within 0.01% of final value within 2 seconds following a programmed change in output current or frequency (10 ms for 5220A alone)

Load Capability: Drives all resistive and capacitive loads consistent with current and compliance voltage capability. Drives inductive loads (with reduced accuracy) up to 200 microhenries, consistent with current and compliance voltage capability

Maximum Isolation Voltage: ±20V dc or 20V ac rms

Temperature Range: 0°C to 50°C (operating) and -20°C to 65°C non-operating

Relative Humidity: ≤50% to 50°C, ≤75% to 40°C, ≤95% to 25°C

Altitude: 0 to 10,000 feet (operating) and 0 to 40,000 feet (non-operating)

Vibration: 2G maximum, 5 Hz to 55 Hz for 15 minutes

Shock: 15G maximum, half sinewaves

Power: 100, 110, 115, 120, 200, 220, 230, or 240V ac +10%, switch-selectable, 50 Hz to 60 Hz, 300 watts

Size: 17.8 cm H x 43.2 cm W x 55.9 cm D (7 in H x 17 in W x 22 in D), case only

Weight: 227 kg (50 lb)

Included: Manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

5220A Transconductance Amplifier	$5650

Accessories (Also see page 485)

Y5020 Current Shunt	700
Y5000* Interface/Buffer	600
Y5002* Cable (Y5000 to 5220A)	240
M00-270-610 20" Slides for Rack Adapter	130
M00-280-610 24" Slides for Rack Adapter	130

**Required when controlled from 5100B or 5101B*

335A & 335D

(NSN 6625-00-445-3328) **335A**

335A & 335D DC Voltage Calibrators/Null Detectors

- 0 to 1100V output, 0 to 50 mA
- 0.1 ppm resolution, seven decades
- Built-in null detector for differential voltage measurements
- 10 ppm basic accuracy (335D)
- 5 ppm basic stability per month (335D)
- Overvoltage and overcurrent protection

Combining accuracy with versatility, Models 335A and 335D provide the functions of a precision dc voltage standard with those of a differential voltmeter and high impedance null detector. The only practical difference between the 335A and the 335D is their accuracy and stability.

Both instruments provide 0.1 ppm resolution, using seven in-line decade switches.

Specifications

Voltage Ranges: 10, 100, and 1000V with outputs as follows: 0 to 11.111110 (1 µV steps), 0 to 111.111110 (10 µV steps), 0 to 1111.1110 (100 µV steps)

Output Current: 0 to 50 mA

Accuracy of Output:* ±(% of Setting + µV)

Range	335A, 90 Days	335D, 60 Days
10V	0.002 + 10	0.001 + 10
100V	0.002 + 20	0.001 + 20
1000V	0.002 + 200	0.0015 + 200

**Also measurement accuracy of 335A and 335D used as a differential voltmeter*

NOTE: Accuracy is absolute, relative to NBS standards, and include effects of stability, line regulation, and calibration uncertainties under standard reference conditions of 23°C ± 1°C and up to 70% relative humidity.

Stability of Output: ±(% of Setting + µV)

Range	335A	335D
10V	±(0.001 + 10)/mo ±(0.002 + 20)/yr	±(0.0005 + 7)/mo —
100V & 1000V	±(0.001 + 20)/mo ±(0.002 + 40)/yr	±(0.0005 + 30)/mo —

Temperature Coefficient: (0.0002% of setting +1 µV)/°C from 22°C to 0°C or 24°C to 50°C

Overcurrent Protection: Limits current at 1 mA to 60 mA via continuously variable front panel control

Overvoltage Protection: Trips output if voltage level exceeds setting of front panel controls. Continuously variable from 10% to 110% of each range

Ripple and Noise: 10V range, ≤20 µV rms; 100V range, ≤30 µV rms; 1000V range, ≤40 µV rms

Settling Time: Typically within 10 ppm of final output less than 20s after a range change

Regulation: 0.0002% of setting or 10 µV for a 10% line voltage change or a full load change

Common Mode Noise Rejection: ≥140 dB from dc to 400 Hz, up to 700V rms or 1000 dV

Isolation: Either output terminal may be floated up to 1000 dV from chassis ground

Remote Sense: Separate terminals are provided for sensing the output voltage directly at the load

Temperature: 0°C to 50°C, operating

Power: 115 or 230V ac ±10%, 40 to 60 Hz, approximately 130 VA fully loaded

Size: 17.8 cm H x 48.2 cm W x 45.7 cm D (7 in H x 19 in W x 18 in D)

Weight: 23 kg (50 lb)

Mounting: Standard 19" EIA relay rack, tapped for attachment of slides; resilient feet provided for bench use

Included: Manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

Item	Price
335A DC Voltage Calibrator/ Null Detector	$11,450
335D DC Voltage Calibrator/Null Detector (NSN 6625-00-361-5246)	11,950

Accessories

(Also see page 485)

Item	Price
A60-01 17-20" Rack Slides	on req

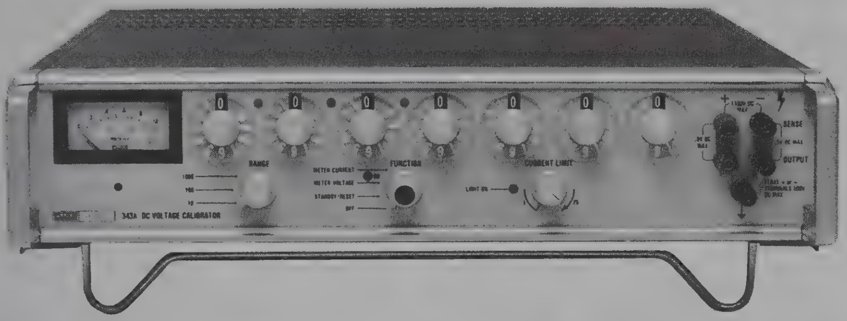
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

Item	Price
SC1-335A Repair (w/ calibration)	557
SC1-335A Repair (cal w/in or out data)	632
SC1-335A Repair (cal w/in and out data)	707
SC2-335A Cal	596
SC2-335A Cal (w/in or out data)	896
SC2-335A Cal (w/in & out data)	1196
SC1-335D Repair (w/ calibration)	658
SC1-335D Repair (cal w/in or out data)	733
SC1-335D Repair (cal w/in and out data)	808
SC2-335D Cal	596
SC2-335D Cal (w/in or out data)	896
SC2-335D Cal (w/in & out data)	1196



(NSN 6625-00-238-1283) **343A**

343A DC Voltage Calibrator

- 0 to 1100V output, 0 to 25 mA
- 0.1 ppm resolution, seven decades
- 20 ppm basic accuracy
- Stability better than 5 ppm/hour, 15 ppm/month

The 343A is a 7-digit instrument with a basic accuracy of 20 ppm and a resolution of 1 µV on the 10 µV range.

Cleanliness of the dc output is evident in the combined ripple and noise specifications of 50 µV rms from the 343A. Short term jitter and other random excursions are almost non-existent, less than 1 ppm.

A simple amplifier/comparator circuit is utilized to establish a convenient, variable, current limiter. Any maximum current output from 1 to 30 mA may be set via a front panel control. In addition to providing for current protection to the load, a failsafe "crowbar" protects the series-pass elements from damage should the total voltage across the elements exceed a safe level.

Specifications

Output Voltage: 0 to 1100 dV
Resolution: 1 µV on 10V range, 10 µV on 100V range, 100 µV on 1000V range

Accuracy, 90 Days
10V Range: ±0.002% of setting or ±0.0002% of range*
100V Range: ±0.002% of setting or ±0.0001% of range*
1000V Range: Same as 100V range

**Whichever is greater*
NOTE: The above accuracies are absolute, relative to NBS standards, and include effects of stability, line regulation, load regulation, and calibration uncertainties under standard reference conditions of 23°C ± 1°C and up to 70% relative humidity after 30 minute warm-up. Apply for 90 days.

Stability: ±% of Setting or ±Microvolts*

Time	10V Range	100V Range	1000V Range
Per Hour	0.005% or 5 µV	0.0005% or 10 µV	0.0005% or 20 µV
Per Month	0.0015% or 15 µV	0.0015% or 25 µV	0.0015% or 50 µV
Per 6 Months	0.0025% or 30 µV	0.0025% or 40 µV	0.0025% or 60 µV

**Whichever is greater*

Temperature Coefficient: ±(3 ppm of setting +0.1 ppm of range +2 µV) per degree Celsius from 24°C to 15°C or 25°C to 35°C
Regulation: <0.0005% of setting +25 µV for a 10% line voltage change or a full-load to no-load change
Isolation: May be floated 500 dV from chassis
Settling Time: Within 15 ppm of final output in 5 seconds
Overcurrent Protection: Automatically limits output current at any preset level between 1 mA and 30 mA via continuously variable front panel control. Panel lamp illuminates during limiting
Meter: Switch-selectable to full range voltage or full range current
Remote Sense: Separate terminals are provided for sensing the output voltage directly at the load
Temperature: 0°C to 50°C, operating
Power: 115 or 230V ac ±10%, 50 to 440 Hz, approximately 60 VA fully loaded
Size: 8.9 cm H x 43.2 cm W x 45.7 cm D (3.5 in H x 17 in W x 18 in D)
Weight: 10.43 kg (23 lb)
Included: Instruction Manual, power cord, serialized and dated calibration certificate

Ordering Information

Model	January 1989 prices
343A DC Voltage Calibrator	$5950

Accessories (Also see page 485)

MEE-7001 3" Rack Adapter	120
MEE-8078 24" Rack Slides for rack adapter	140
MEE-8079 18" Rack Slides for rack adapter	150

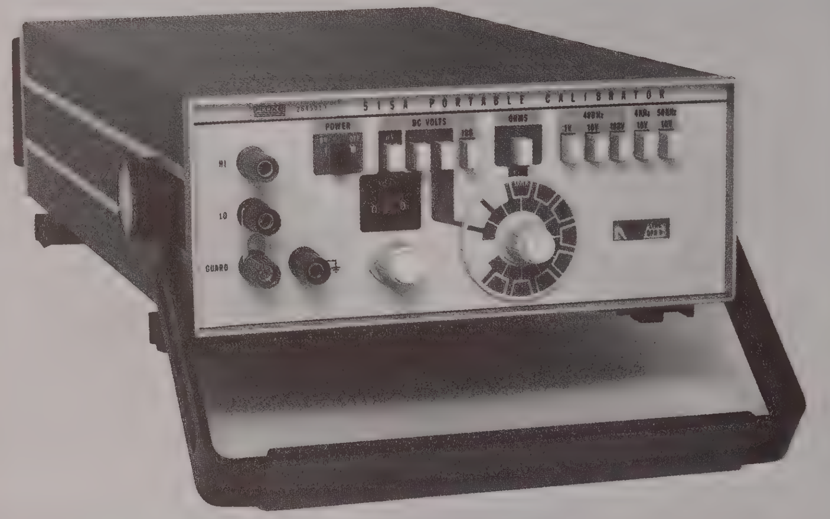
Service & Support

Warranty
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-343A Repair (w/calibration)	231
SC1-343A Repair (cal w/in or out data)	306
SC1-343A Repair (cal w/in and out data)	381
SC2-343A Cal	252
SC2-343A Cal (w/in or out data)	402
SC2-343A Cal (w/in & out data)	552

515A



(NSN 6625-01-086-204) **515A**

515A Portable Calibrator

- Precision, portable, 4-1/2 digit calibration and 5-1/2 digit verification where you need it
- Battery powered when disconnected from line power
- Lightweight and small size

The Model 515A Portable Calibrator is a precision voltage and resistance calibration source for on-site calibration of measuring instruments. The 515A provides direct and alternating voltage and resistance standards in a unit only 3-1/2 inches high by 8-1/2 inches wide by 16 inches deep. The instrument weighs just 13 pounds, including the rechargeable battery pack, which eliminates warm-up delays after transit and allows 8-hour operation free of line power for true portability. The 515A's basic uncertainty is specified over a temperature range of 18°C to 28°C for a 1-year period, thus making it easy to use in production test and calibration environments without complex correction terms. The long calibration cycle also makes the 515A economical to own by minimizing maintenance overhead costs.

All 515A outputs are available at a single set of output terminals. In addition, terminals are available to allow guarding and shielding of test leads in critical test situations.

If the unit is connected to the ac line, the internal battery is placed on charge; otherwise the 515A automatically operates from the battery and its state of charge is indicated on the meter to the right of the panel.

The 515A can be used effectively to test a wide range of characteristics in measuring instruments. Here are a few of the many applications:

dV: Input offset current, a/d linearity, absolute accuracy

aV: Frequency response, converter linearity, residual noise, absolute accuracy

Resistance: Linearity, residual resistance, absolute accuracy

General: Zero offset and stability, autoranging, overranging

Specifications

Technical Specifications

Direct Voltage

Ranges

μV: 0 to 99 μV continuous (0.2 μV resolution)
1V: 0 to 1.0V in 0.1V steps
10V: 0 to 10V in 1V steps
100V: 100V cardinal point

Accuracy: (For 1 year, 18°C to 28°C, 30 min warm-up)

μV range: ±2 μV
1V, 10V, and 100V ranges: ±30 ppm or 30 μV of range, whichever is greater

Output Current: Function of source resistance, except 100V range which is limited at approximately 0.5 mA. No damage to instrument with short circuit on output.

Source Resistance

μV, 1V, 10V ranges: 300Ω
100V range: <1Ω (up to 0.5 mA load)

Alternating Voltage

Range: 1V, 10V, 100V cardinal points

Output Frequencies

10V: 400 Hz, 4 kHz, 50 kHz
1V, 100V: 400 Hz

Accuracy: (For 1 year, 18°C to 28°C, 30 min warm-up)

1V: ±0.05%
10V: ±0.04% at 400 Hz and 4 kHz. ±0.1% at 50 kHz
100V: ±0.06%

Frequency Accuracy: ±1% except at 50 kHz ±5%

Total Harmonic Distortion and Noise: <0.03% (400 Hz and 4 kHz), <0.05% (50 kHz)

Output Current

1V, 10V output: 0 to 10 mA rms
100V output: 0 to 0.5 mA rms

Resistance

Range: 10Ω through 10 MΩ in decade steps + zero setting

Accuracy: (1 year, 18°C to 28°C, referred to "0"Ω position)

0Ω - Residual resistance is less than 0.15Ω
10Ω - 100Ω: ±0.06%
1 kΩ- 1 MΩ: ±0.015%
10 MΩ: ±0.075%

Power Rating: 0.2W or 100V (dc or rms), whichever is less

General Specifications

Temperature: 0°C to 50°C, operating

Power: 100, 115, 200, 230V ac, ±10%, 50 to 440 Hz, <10W, or internal batteries. Eight hours operation from batteries when fully charged

Weight: 5.9 kg (13 lb)

Size: 8.9 cm H x 21.6 cm W x 40.6 cm D (3.5 in H x 8.5 in W x 16 in D)

Included: Manual, power cord, batteries, serialized and dated calibration certificate

Ordering Information

Model	January 1989 prices
515A Calibrator	$4695

Accessories (Also see page 485)

M03-200-618 3" Rack Adapter, Dual	75
M03-200-619 3" Rack Adapter, Single, Offset	105
M03-200-620 Panel Mounting Kit	60
M03-203-700 Panel Protector	26

Y5020

Y5020

Y5020 AC or DC Current Shunt

- Rated to 20A dc to 5 kHz
- 100 ppm uncertainty
- 10 milliohms nominal resistance
- Less than 250 mV burden

The Y5020 Current Shunt is a very stable, non-inductive, four-terminal resistive current shunt. It may be used to verify the accuracy of the 5220A Transconductance Amplifier or other current calibrators. It is an inexpensive method of accurately measuring current up to 20 amperes, from dc to 5 kHz. The 0.01Ω nominal resistance creates less than 250 mV burden. A forced-air cooling fan stabilizes internal ambient temperature during use.

Specifications

The following specifications apply for one year, provided the Y5020 is operated with its cooling fan in ambient temperatures from 18°C to 28°C. Voltage terminals must be connected to a measurement circuit with an input resistance of 1 MΩ or greater and a capacitance of 500 pf or less.

Nominal Resistance: 0.01Ω ±1%
Uncertainty:* Direct current, ±100 ppm; alternating current, ±(150 ppm + 120 ppm x frequency in kHz) relative to direct current specification
** Referenced to the certified absolute value of shunt resistance stamped on the front panel*
Stability: Less than 20 ppm resistance change in six months
Maximum Current: 20A direct current or rms aternating current
Burden Voltage: Less than 250 mV at 20A
Temperature Coefficient: Less than 20 ppm/°C; 0°C to 18°C and 28°C to 50°C
Power Coefficient: Less than 12 ppm per watt
Operating Temperature: 0°C to 50°C ambient
Storage Temperature: -40°C to 70°C
Input Power:* 115V or 230V ac ±10%, 11 watts
Size: 12.7 cm H x 20.5 cm W x 3.6 cm D (5.0 in H x 8.0 in W x 12.9 in D)
Included: Instruction sheet
** For cooling fan. Specify 115V or 230V when ordering*

Ordering Information

Model	January 1989 prices
Y5020* Current Shunt	$700

**Specify supply voltage (e.g., Y5020-115 or Y5020-230)*

Service & Support

Warranty

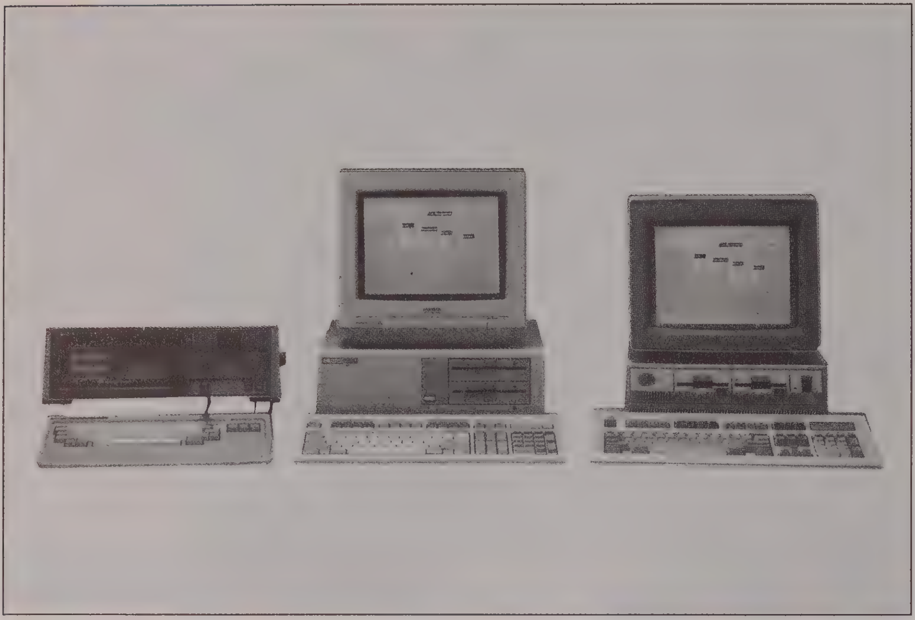
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-Y5020 Repair (w/calibration)..........	43
SC1-Y5020 Repair (cal w/in or out data)	78
SC1-Y5020 Repair (cal w/in and out data)	113
SC2-Y5020 Cal	104
SC2-Y5020 Cal (w/in or out data)	139
SC2-Y5020 Cal (w/in and out data)	174

Introduction

NEW



Fluke Calibration Systems and Software

New

- Personal Computers as System Controllers With:
  - True GPIB SRQ Interrupt Handlers
  - Near Photo Quality Color Graphics
  - On-Line Help Screens
  - Full Screen Procedure Editor
- SDF Compatible Traceability Files in all Software
- SDF Compatible Test Report Header Data File
- Customized Test Report Header Format
- Fluke 5700A and 8842A in Systems
- High Accuracy Meter Calibration Systems
- Lab-Cart based Mobile Calibration

Improved

- Procedure Editing
- GPIB I/O for Closed Loop Calibration
- Test Results Data Formatting and Pagination

Experience counts

Automating the calibration lab is no simple task. Many questions arise. Will the system you choose meet all of your workload requirements? Can it be integrated with other systems now or in the future? Will you be able to use all the capabilities of the instruments in the system? Will it meet your reporting needs? How difficult will it be to write or edit procedures and will they be compatible with the way your lab operates? Will your non-technical personnel be able to use the system effectively? Is the system software in wide use, with strong vendor support and continuous improvements.

At Fluke, we have been building automated calibration systems for more than 15 years. We understand your needs. And we know what it takes to meet them. That's why more labs automate the calibration of dc and low frequency ac test and measurement instruments with Fluke systems than any other.

Fluke Software. The heart of your automated system.

An automated calibration system is no better than its software. Software impacts everything from who can use the system to the workload it can process.

At the heart of every Fluke automated calibration system is Fluke software, designed by calibration professionals specifically for people who work in calibration labs.

Fluke software is designed to control all the functions and capabilities of a very broad selection of calibration instruments. So you can choose the tools that cover your workload now, and add to your system later as your workload changes.

With Fluke calibration software, you don't need to be a computer programmer to generate calibration procedures. A familiar, procedure-oriented language makes generating procedures easy. Plus, Fluke offers example procedures that will give you a head start at writing your own.

It's easy to select a system that fits both your workload and your budget.

Fluke automated systems give you flexibility in matching your calibration workload to your budget. You have a choice of controllers, DMM and oscilloscope calibrators, packaging and an extensive selection of auxiliary instruments. You can start small and add or change instruments as your workload needs change. Fluke makes it easy.

We stand behind every system we sell.

With Fluke support, you leave nothing to chance. We can help you design your system. When it's complete, a Fluke application engineer will install and test it, and will work with you and your technicians to get your system up and running fast.

So that you can get the maximum out of your system and the instruments in it, Fluke also offers a wide range of maintenance, procedure writing, metrology and lab management training courses. These courses are held regularly at selected Fluke Service Centers. For groups up to eight, we can bring a course to your site.

Why automate?

The calibration process typically includes several steps that are ideally suited to automation. You need to locate and recall an instrument, consult the manual for its calibration procedures and specifications, verify and adjust the instrument, record results, generate reports and calibration certificates, and return the instrument to the user.

It's time consuming. At every step of the way, the potential for errors is considerable. And the longer the process takes, the longer an instrument is kept out of the hands of its owner.

Automation increases your lab's throughput and productivity.

Operating a Fluke automated calibration system is simple for technicians of all skill levels. Clear, plain-language instructions and illustrations prompt the user through each step of the process. Even entry level technicians can calibrate complicated instruments confidently and efficiently.

Because the procedure is in software, there is no need to consult a manual. And results information is automatically recorded as a matter of course.

For modern instruments with an IEEE-488 interface and software calibration capability, the system can perform the calibration "closed loop, closed case" very quickly, with little intervention by the operator.

Finally, Fluke automated calibration systems make fast work of verifying and adjusting the instrument. Your lab can process more work in less time, so downtime due to calibration recall is reduced.

Automation enhances the quality and consistency of your calibrations.

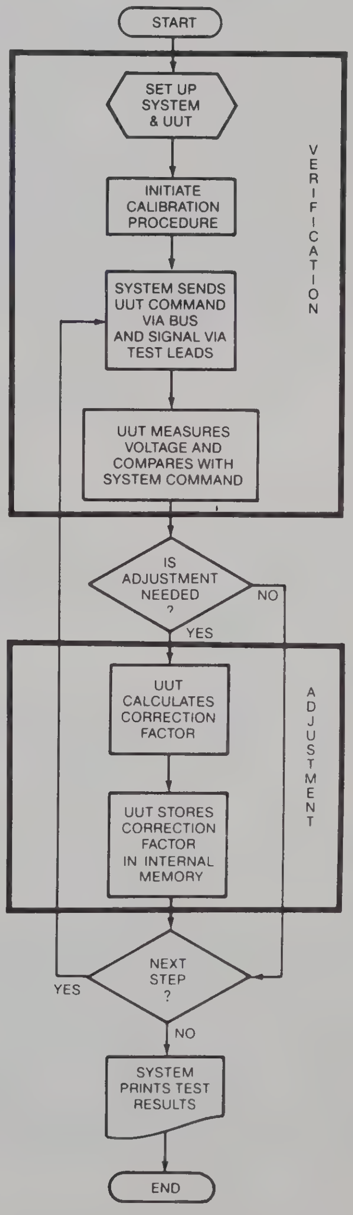
Because calibration procedures run under the control of the system controller, each one is run the same way every time in every location where it is used. Decisions about what function to verify, when to perform a task and whether or not a reading is within tolerance, are made within the system, rather than by the operator. And because you write the procedure, it reflects your calibration philosophy and practice.

Automation streamlines your data management tasks.

Recording and reporting information is one of the most time-consuming phases of the calibration process. Yet it is critical to maintaining the traceability of your lab.

Because your procedures are stored by the system controller, you have a complete record of how your instruments are verified. Fluke calibration software also automatically records results information about every instrument you calibrate. In fact, Fluke software even maintains traceability information about the calibration instruments in the system. And that information can be reported in a variety of formats, as your requirements dictate. Or you can analyze the information off-line to determine instrument performance trends or to establish efficient recall schedules.

How Does Closed-Loop Calibration Work?


START
SET UP SYSTEM & UUT
INITIATE CALIBRATION PROCEDURE
SYSTEM SENDS UUT COMMAND VIA BUS AND SIGNAL VIA TEST LEADS
UUT MEASURES VOLTAGE AND COMPARES WITH SYSTEM COMMAND
VERIFICATION
IS ADJUSTMENT NEEDED ?
NO
YES
UUT CALCULATES CORRECTION FACTOR
UUT STORES CORRECTION FACTOR IN INTERNAL MEMORY
ADJUSTMENT
NEXT STEP ?
YES
NO
SYSTEM PRINTS TEST RESULTS
END

Fluke 7411 Series Calibration Software.

Software is the heart of any automated calibration system. Any system is only as fast, as capable or as easy to use as its software.

Fluke 7411 Series Calibration Software represents more than 15 years of experience in automating the cal lab. It is designed to be used by calibration technicians, not computer programmers. And its capabilities are driven by your need for workload coverage, flexibility and calibration data acquisition.

In addition to permitting you flexibility in the calibration instruments you choose for your system, Fluke 7411 Series Calibration Software offers you a choice in system controllers: the Fluke 1722A Touch Screen Instrument Controller, Hewlett Packard Vectra ES12 or IBM PS/2 Model 50.

Users who are familiar with earlier versions of 7411 Software for the Fluke 1722A Controller will be able to use 7411PC with little or no training. 7411B procedures are upward compatible with 7411PC with the use of a translator utility.

A comparison of the Fluke 1722A Instrument Controller, HP Vectra ES12 and IBM PS/2 Model 50 in an automated calibration system.

	Fluke 1722A	HP Vectra	PS/2-50
SRM Access Possible	No	Yes	No
3rd Party Software Available	Limited	Yes	Yes
Operator Interface	Touch Sense Monitor Operators' Aid standard	Keyboard Operators' Aid optional	Keyboard Operators' Aid optional
Rack Mount Monitor	Yes	No	No
Monitor	Mono.	Color	Color
Hard Disk	External	Internal	Internal
Direct Network Compatibility	No	Yes	Yes
Ruggedness	Excellent	Good	Good

Simple procedure generation.

When you sit down to write a calibration procedure, you use calibration oriented Function Selection Codes (FSCs). You then enter the procedural data that will be used by the FSC in carrying out the function. For example, for FSCs that select a calibrator, the relevant procedural data would specify such factors as the output and tolerance. There is no need to generate cumbersome flow charts or intermediate code before you can use your procedure.

No programming. FSCs save you time by condensing multiple programming instructions into a single, easily recognizable selection. Typically, these are either instrument model numbers (5700) or English words (EVALuate). FSCs eliminate the programming knowledge usually necessary to perform complex tasks. With 7411 Series Calibration Software, you simply select the FSC you want and insert the appropriate calibration parameters. The software does the rest.

Automatic procedure checking. While you are writing a procedure, the calibration software checks it for accuracy. For example, it compares the outputs you specify with the capabilities of the calibrator used and alerts you if a command is outside the calibrator's range.

Example procedures. When you purchase 7411 Series Calibration Software, you get a set of example procedures at no extra cost. You can use these procedures in their existing form, or edit them as required to fit your equipment configuration, your cal lab philosophy or other factors specific to your application.

Example Procedures

	7411C and 7411PC	
METERS	**Verification**	**Adjustment**
Fluke		
21	•	•
23	•	•
25	•	•
37	•	•
73	•	•
75	•	•
77	•	•
8000A	•	•
8020B	•	•
8021A	•	•
8022A	•	•
8024A	•	•
8026A	•	•
8050A	•	•
8060A	•	•
8840A	•	•
Hewlett-Packard		
3478A	•	•
OSCILLOSCOPES		
Hewlett-Packard		
182A	•	
1801A	•	
1820B	•	
Tektronix		
465A	•	•
2215A	•	

Simple operation.

When you run a calibration procedure on a Fluke automated calibration system, the software does the hard work. It not only leads the operator through the procedure itself, but also handles many of the tasks that are usually done by the operator — from taking the measurements to calculating and recording the error of the unit under test.

Automated calibration. For the calibration of instruments that do not have an IEEE-488 interface, the software guides the operator through the procedure and performs the necessary calculations, helping the operator to make the actual changes to the unit.

Once the calibration procedure has been loaded, step-by-step instructions and graphics on the controller's display guide the operator through each task, allowing even inexperienced operators to perform complex calibration procedures with very little training. In addition, this close guidance assures you that calibration procedures are followed to the letter.

Closed-loop calibration. If the instrument to be calibrated has an IEEE-488 interface, you can save even more time by performing closed-loop calibration.

Closed-loop calibration begins with the operator identifying the unit to be calibrated and the system loading the appropriate procedure. The system then prompts the operator to connect the necessary test leads, sets the unit to the proper range and function, applies the calibrated output from the calibration instruments, evaluates the unit's reading, then proceeds to the next step until the unit has been completely verified with little or no operator intervention.

If the unit under test is capable of software adjustment, like the Fluke 8840 Series DMMs, the system can also make the necessary adjustments by storing correction factors in the unit's non-volatile memory. Otherwise, the system advises the operator of the necessary adjustments. Because of its graphics capability, procedures in Fluke calibration software can incorporate illustrations where necessary to show the operator where to make connections or adjustments.

Flexible Test Reporting

When the calibration procedure is completed, the cal results data is available in printouts with user-defined headers. In addition, a test summary and traceability data are available in a Standard Data Format (SDF) delimited file for use with your data management software.

A comparison of Fluke 7411C and 7411PC Software

Feature	7411C	7411PC
Runs on the Fluke 1722A IInstrument Controller.	•	
Runs on the properly configured HP Vectra ES12 or IBM PS/2-50 computers.		•
True interrupt handling of GPIB Service Requests (SRQs)	•	•
Accepts user-defined Test Uncertainty Ratios (TUR's), warns when too low		•
Test results report includes system uncertainty		•
Includes system traceability file	•	•
User-configurable header for test results printout	•	•
Automated cal results printout and data recording	•	•
Test results header data and traceability file in Standard Data Format (SDF) for use with spreadsheets and database software	•	•
Easy procedure writing and editing. No cumbersome flow charts or intermediate code required	•	•
Extensive on-line help		•
Supports high-resolution color graphics		•
Compatible with 3rd party text editors		•
Touch sense CRT operator interface	•	
Operator messages can be edited	•	•
Simple system expansion	•	•
Upward compatibility for procedures generated on previous versions of 7411 software	•	•

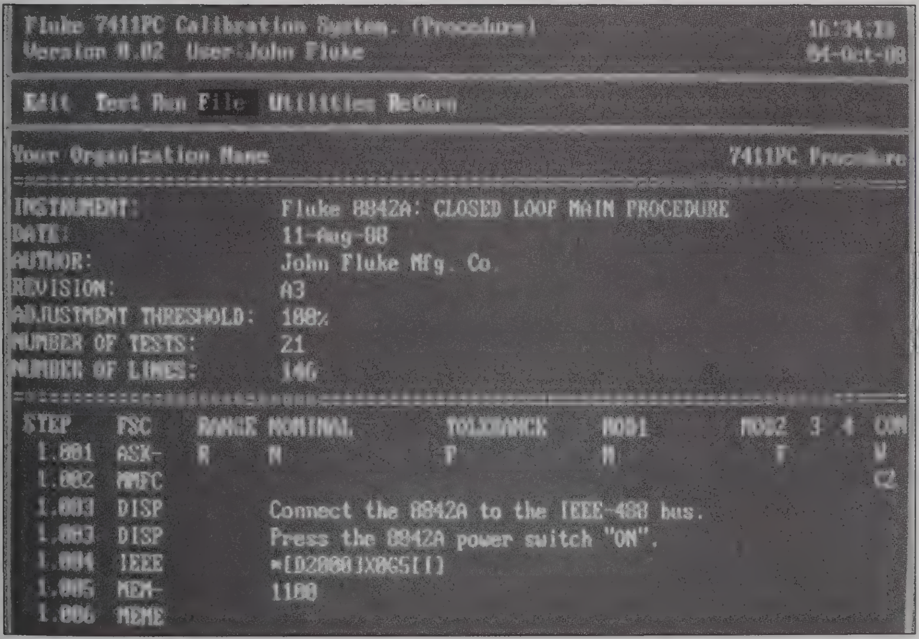
Instrument Driver Function Selection Codes

Instrument	7411PC	7411C
Fluke		
5100B	•	•
5101B	•	•
5200A	• *	• **
5205A	•	•
5215A	•	•
5220A	•	•
5440B	•	•
5450A	•	•
5700A (New)	•	•
6060B	•	•
6061A	•	•
6062A	•	•
8502A	•	•
8505A	•	•
8506A	•	•
8842A (New)	•	•
Tektronix		
CG5001	•	•

** Does not include 5200A accuracy enhancement software*

***Includes 5200A accuracy enhancement software*

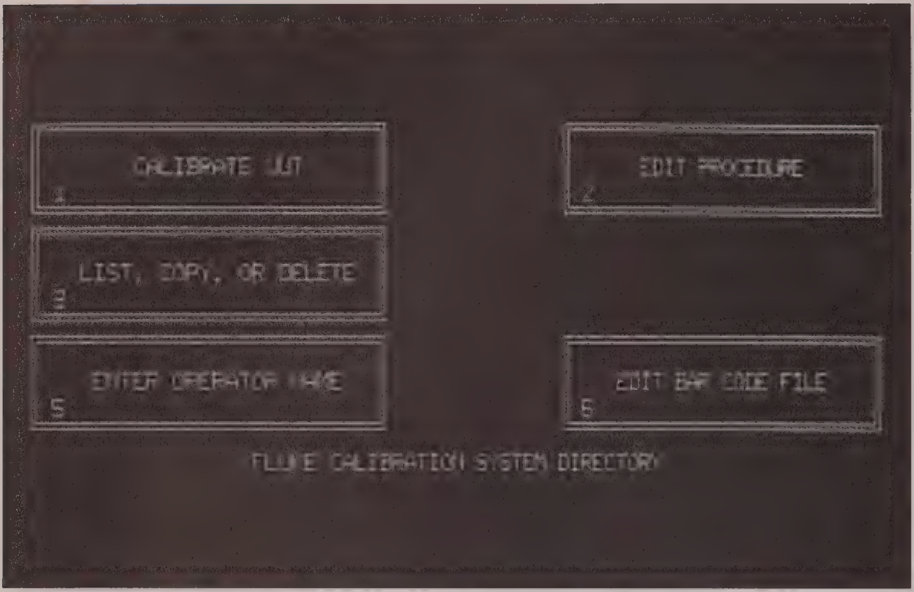
Example of 7411PC Procedure Listing



```
Fluke 7411PC Calibration System. (Procedure)                16:34:38
Version 0.02  User John Fluke                               04-Oct-88

Your Organization Name                                 7411PC Procedure
========================================================================
INSTRUMENT:              Fluke 8842A: CLOSED LOOP MAIN PROCEDURE
DATE:                    11-Aug-88
AUTHOR:                  John Fluke Mfg. Co.
REVISION:                A3
ADJUSTMENT THRESHOLD:    100%
NUMBER OF TESTS:         21
NUMBER OF LINES:         146
========================================================================
STEP   FSC    RANGE NOMINAL       TOLERANCE    MOD1        MOD2  3  4  CON
 1.001 ASK-   R     N             T            M           T           W
 1.002 MMFC                                                            C2
 1.003 DISP        Connect the 8842A to the IEEE-488 bus.
 1.003 DISP        Press the 8842A power switch "ON".
 1.004 IEEE        *[D2000]X0G5[I]
 1.005 MEM-        1100
 1.006 MEME
```

7411C



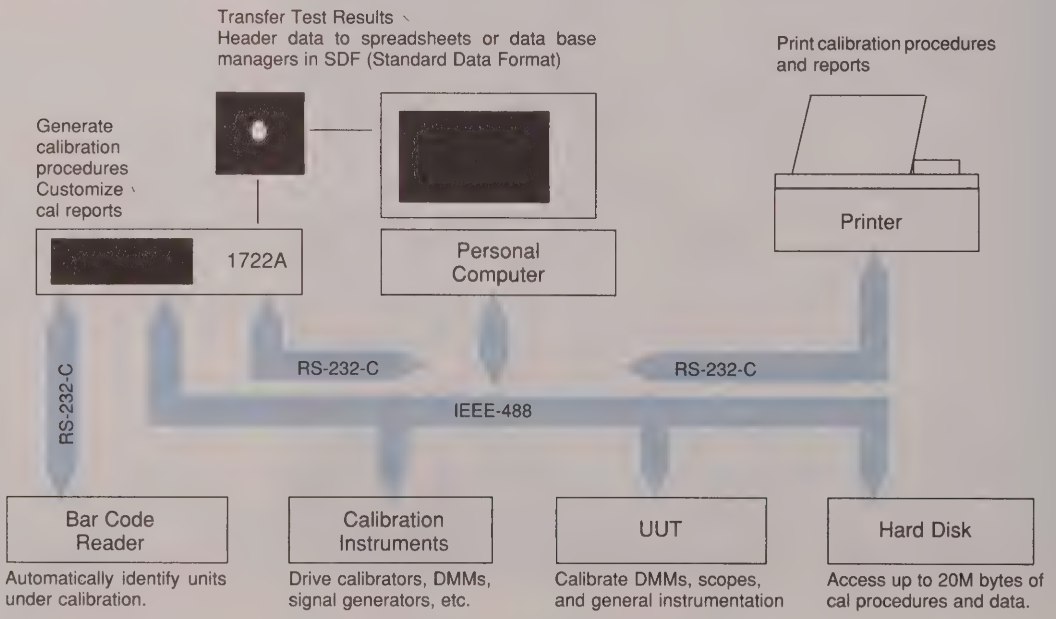
7411C Main Menu with touch-sense selection or numeric selection via keyboard.

Features of 7411C Calibration Software for the Fluke 1722A Touch Screen Instrument Controller.

- Procedures are easy to generate and edit. No programming experience, cumbersome flow charts or intermediate code are required. Example procedures are supplied at no extra charge.
- System operation is easy. Plain language instructions and graphics and the 1722A's touch-sensitive screen and Operators' Aid make entering commands simple and intuitive.
- Test results are automatically recorded.
- Information about the calibration instruments in the system are recorded in a traceability file.
- Cal results data can be off-loaded to a PC or other computer for additional processing and analysis.
- 7411C supports a wide variety of calibration instruments.
- System expansion is simple.
- For existing 7411B users a 5100B to 5700A procedure translation utility is included at no extra charge.

Ordering Information

7411C Calibration Software $2995


Transfer Test Results Header data to spreadsheets or data base managers in SDF (Standard Data Format)
Print calibration procedures and reports
Generate calibration procedures
Customize cal reports
1722A
Personal Computer
Printer
RS-232-C
RS-232-C
IEEE-488
RS-232-C
Bar Code Reader
Automatically identify units under calibration.
Calibration Instruments
Drive calibrators, DMMs, signal generators, etc.
UUT
Calibrate DMMs, scopes, and general instrumentation
Hard Disk
Access up to 20M bytes of cal procedures and data.

7411C Calibration Software Environment

7411PC

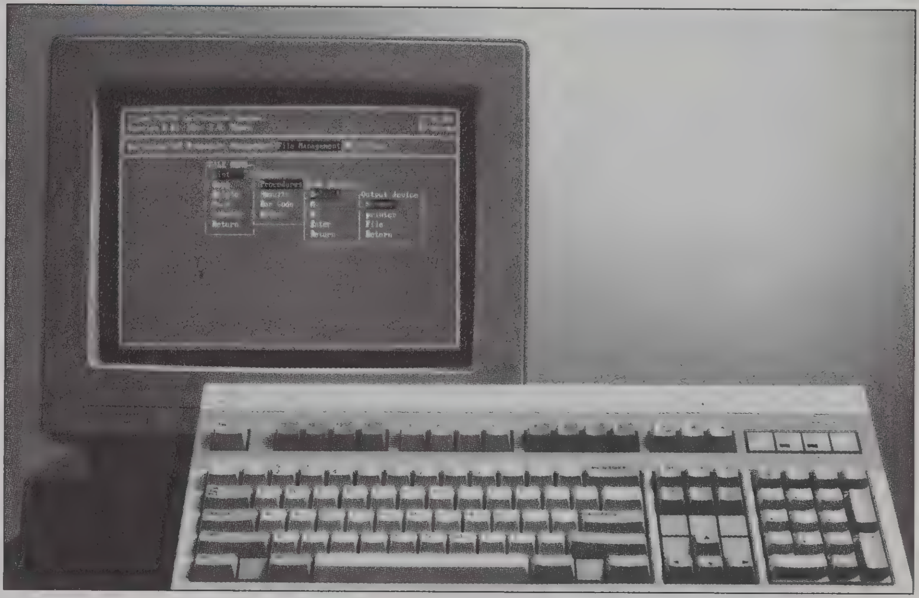
GPIB
IEEE-488

RS-232

NEW

Features of 7411PC Calibration Software for properly configured the HP Vectra ES12 and IBM PS/2 Model 50 computers.

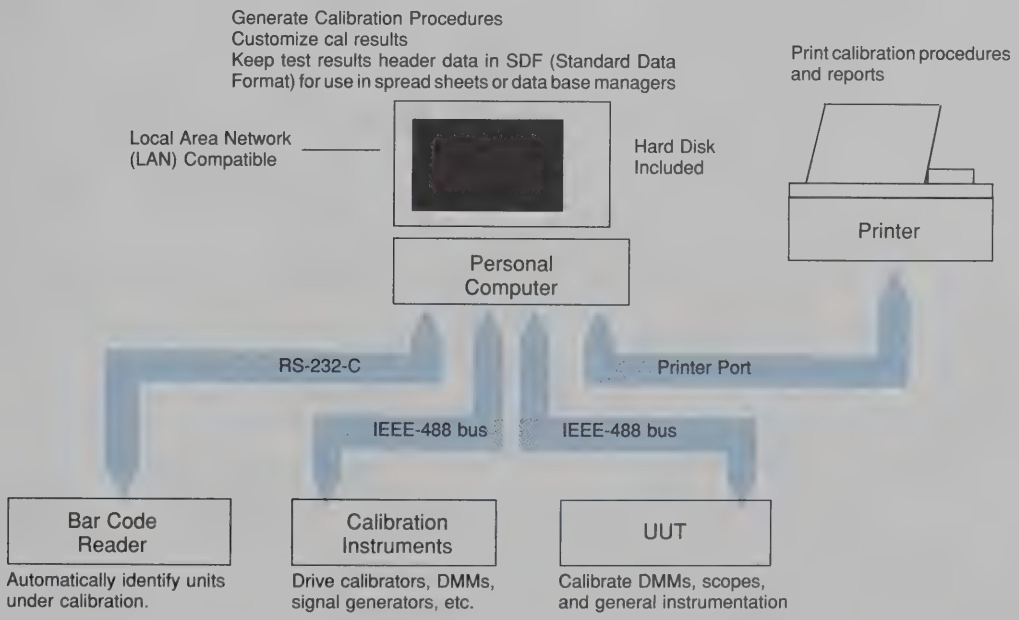
- High resolution color graphics display. Near photo quality illustrations can be included in procedures to prompt the operator.
- All selections are displayed through "pull-down" menus.
- A full screen procedure editor with on-line help is included. Procedures can be generated and run without exiting and reloading parts of the system.
- Commercially available text editors can be substituted for the procedure editor if you desire.
- Comprehensive on-line help screens are included.
- Built-in debugging capability makes it easy to find errors in procedures.
- System accuracy files maintain the operating specifications for each instrument in the system. During procedure generation, when this feature is enabled, the system will alert you if you attempt to verify an instrument with a test uncertainty ratio of less than 4:1.
- All prompts and report formats are stored in ASCII files, so they can easily be edited to fit your application.
- Results report header formats are very flexible, permitting you to include information on a variety of parameters as your documentation requirements dictate.



7411PC Menu Tree with keyboard selection via cursor movement or alpha entry.

Ordering Information

7411PC Calibration Software $4195


Generate Calibration Procedures
Customize cal results
Keep test results header data in SDF (Standard Data Format) for use in spread sheets or data base managers
Print calibration procedures and reports
Local Area Network (LAN) Compatible
Hard Disk Included
Printer
Personal Computer
RS-232-C
Printer Port
IEEE-488 bus
IEEE-488 bus
Bar Code Reader
Calibration Instruments
UUT
Automatically identify units under calibration.
Drive calibrators, DMMs, signal generators, etc.
Calibrate DMMs, scopes, and general instrumentation

7411PC Calibration Software Environment

Systems

NEW

Fluke Standard Automated Calibration Systems

Fluke Standard Automated Calibration Systems are designed to offer you a complete solution to the complex task of matching the calibrator, host computer and software, packaging and other accessories with your workload requirements and your budget. As a single vendor, we stand behind your whole system, not just parts of it, from delivery and set-up through training and support.

Fluke offers three standard systems, based on the workload you need to address:

- The 7457A system is based on the Fluke 5700A Calibrator. It addresses the broadest cross section of meters in your workload. Also, because of the 5700A Calibrator's exceptional temperature tolerance, the 7457A system is ideally suited for on-site calibration applications outside the calibration lab.
- The 7451A system is based on the Fluke 5100B Calibrator. It addresses the calibration of medium accuracy multimeters up to 4½ digits, or up to 5½ digits with the 74XXX-8506A accuracy enhancement option.
- The 7409B system is based on the Tektronix CG5001 Oscilloscope Calibrator. It can be configured as a stand-alone system, with its own controller. Or it can be ordered without a controller and operated by the controller in a 7451A or 7457A system.

Each Fluke automated calibration system* comes with one day of start-up assistance. Your system will be delivered by a Fluke application engineer who will unpack it, run functional tests and work with you and your technicians to get it up and running fast.

Depending on your application and the instruments you buy, Fluke Calibration Systems can be packaged in three ways.

For stationary use, instruments may be simply "stacked" together in a bench-top cluster, with no packaging required.

For semi-mobile applications, you can order your Fluke system mounted in a standard 19" wide instrument rack. Rack installation permits a system to be moved about the lab with relative ease while protecting the instruments in it from damage. A single panel provides for single-switch power and brings interface ports forward to the front of the rack. Fluke racks are constructed of heavy-gauge steel. The sides are removable for easy service. All necessary hardware, controller, interface panel, power distribution and ventilation are included, and the rack is delivered from the factory with all instruments installed. If you don't order all the instrument options for a particular rack, all the hardware necessary to install that instrument later is included with the rack.

The Lab Cart is a simple, inexpensive alternative to rack-mounting your system. This sturdy, open frame cart has 4" wheels for easy mobility and space for a calibrator, amplifier, controller and monitor.

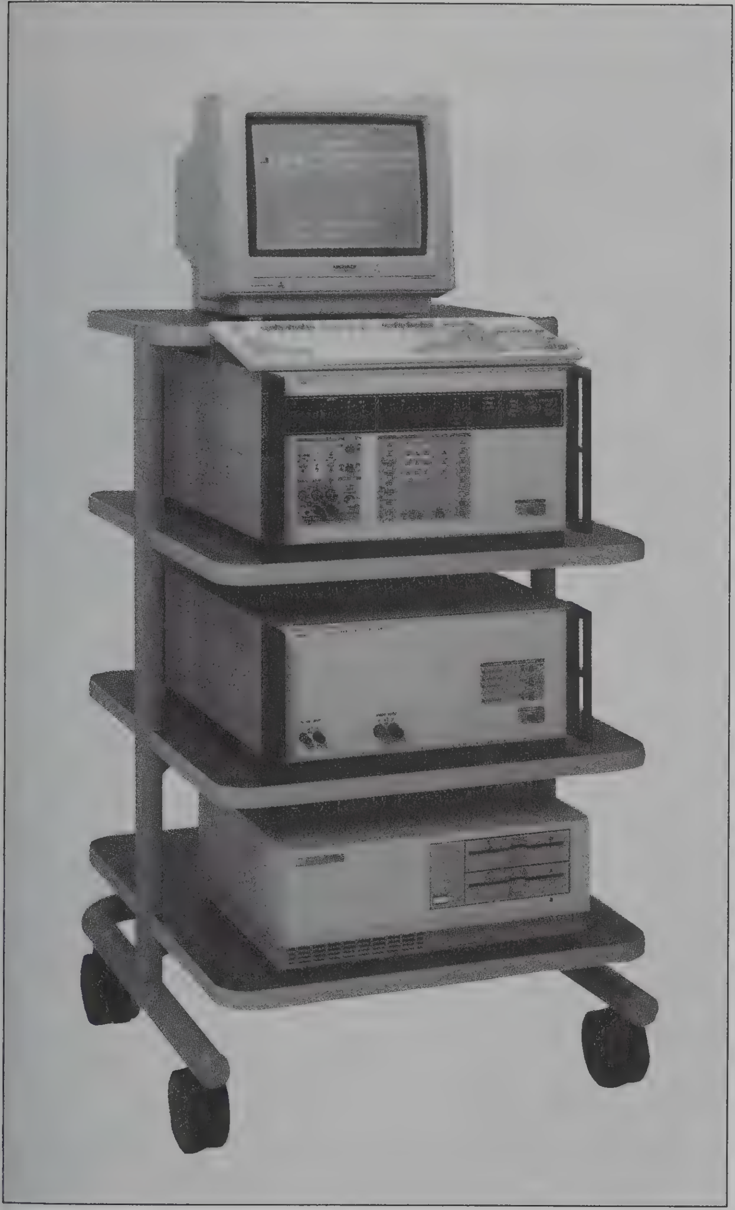
For mobile applications, any of the rack-mount systems may be ordered with a mobile base that includes semi-pneumatic wheels rather than casters. These wheels isolate the rack from shocks while making it easy to roll the system over such obstacles as expansion joints, cracks, door thresholds, rough surfaces, and so on.

In the following pages you will find a Selection Tree for each of the three standard systems Fluke offers. First, determine the workload you need to cover and the calibrator that meets it. Then simply work your way down the tree, choosing the controller, auxiliary instruments, packaging, lab carts and other accessories that best fit your lab's requirements.

**Defined as a Calibrator, Controller, and Software ordered together*

7457A PC Controlled Calibration Clusters

PC also available for 7451A and 7409B

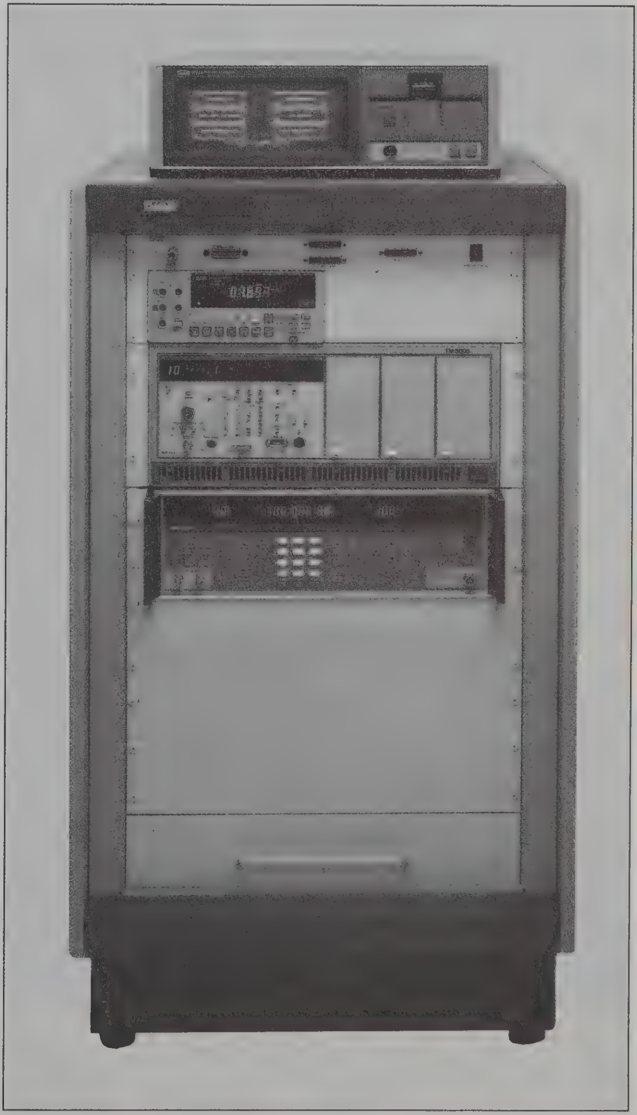


7451A Lab-Cart Cluster

Lab-Cart also available for 7457A and 7409B

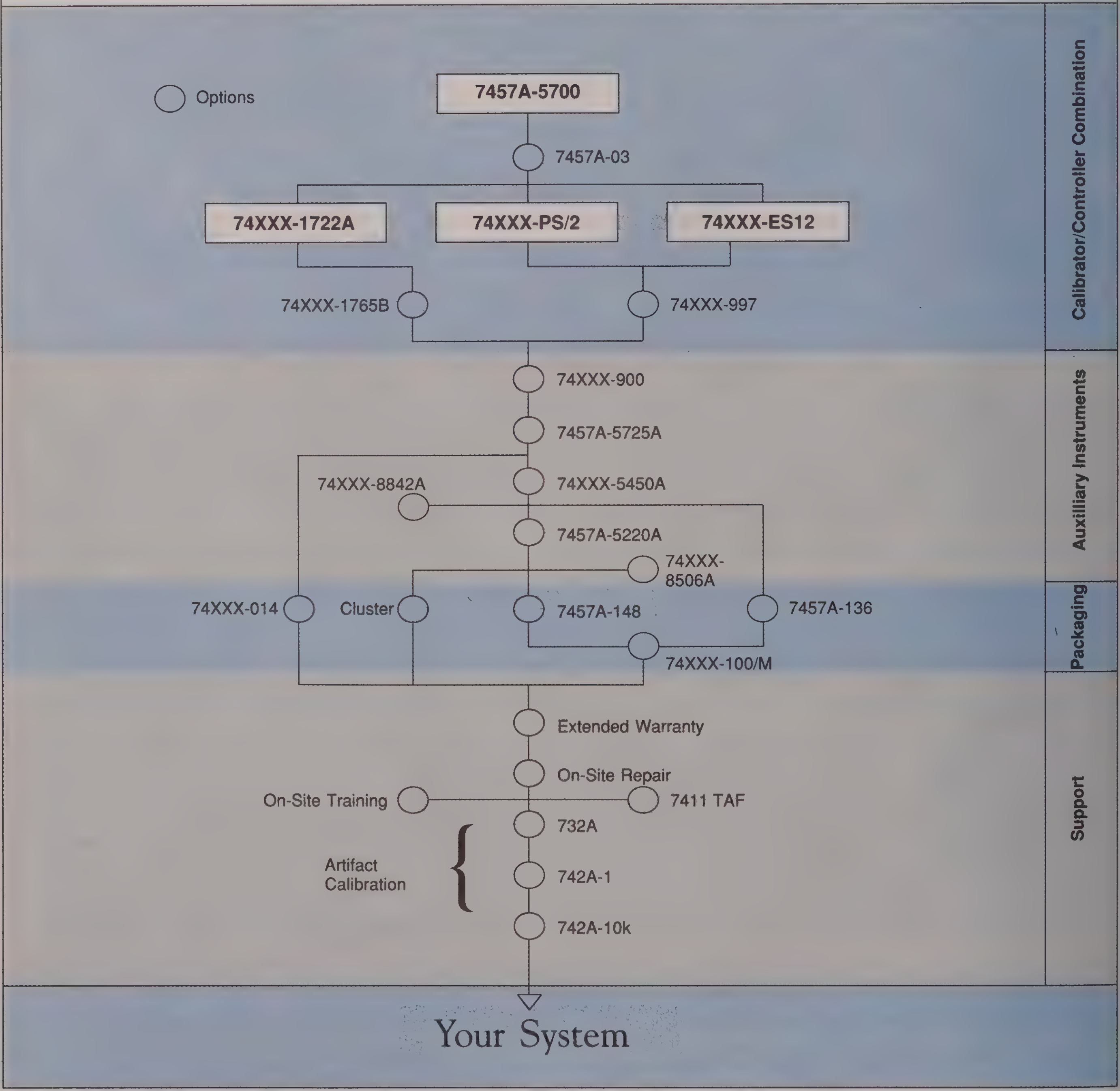
7409B Rack Mounted System

Rack Mounting and 1722A control also available for 7457A and 7451A



7457A

7457 Automated Calibration System



7457A Automated Meter Calibration Systems

The 7457A is Fluke's highest performance standard system. It is designed to calibrate a wide range of instrumentation in your dc and low frequency ac workload. Due to the 5700A's unique, environmentally tolerant design, 7457A systems are an excellent choice for calibrating high performance instrumentation on site.

Choose your calibrator.

7457A-5700A Calibrator. $20,075
Designed to cover the complete meter cal workload. Sources five functions: Direct voltage to 1100V. Alternating voltage from 200 µV to 1100V with frequencies from 10 Hz to 1 MHz. Resistance from 1Ω to 100 MΩ in x1 and x1.9 values including a short. Alternating and direct current to 2.2A with alternating current output available over frequencies from 10 Hz to 10 kHz. IEEE-488 cable is included. For complete specifications, ask for Fluke document A0296.

Option. 7457A-03 Wideband Voltage. $3,995
Extends the 5700A's frequencyrange to 30 MHz to cover to RF voltmeters.

Choose your system controller.

74XXX-1722A Touch Screen Instrument Controller. $10,875
Includes 7411C Software configured for your system. Easy re-configuration means you can add new instruments at any time. Also included: 1 Mbyte memory expansion. Two IEEE-488/RS-232 interfaces. Operators' Aid. 400 kbyte 5$^1/_4$" floppy disk drive. AC divider. IEEE-488 cable for unit under test (UUT) control.

Option. 74XXX-1765B 20 Mbyte Hard Disk Drive. $3,420
Increases storage capacity and system speed. Eliminates the need to use floppy disks for most operations. Includes IEEE-488 cable for connection to the 1722A.

74XXX-ES12 Controller. $12,616
This selection features the Hewlett-Packard Vectra Model ES12 configured as a system controller. Includes 7411PC Software configured for your system. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 12 MHz 80286 processor. 20 Mbyte hard disk drive. 640 kbyte RAM. Floppy and hard disk controller. Two RS-232 ports. Two parallel ports. One 1.2 Mbyte, 5$^1/_4$" and one 360 kbyte 5$^1/_4$" floppy disk drive. Two IEEE-488 control ports. DOS 3.3. HP EGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

74XXX-PS/2 Controller. $12,861
This selection features the IBM PS/2 Model 50 configured as an instrument controller. Includes 7411PC Software configured for your system. Easy re-configuration means you can add new instruments at any time. The hardware configuration includes: 10 MHz 80286 processor. 20 Mbyte hard disk drive. 1 Mbyte RAM. Floppy and hard disk controller. Three RS-232 ports. One parallel port. Two 1.44 Mbyte, 3$^1/_2$" floppy disk drives. Two IEEE-488 control ports. DOS 3.3. IBM VGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

Choose your auxiliary instruments.

7457A-5725A Amplifier. $7980
Boosts the 5700A Calibrator's current output to 11A for calibration of the higher current ranges of handheld and other meters. It also extends the 5700A's alternating voltage capability to 1100V at 30 kHz and 750V at 100 kHz for calibrating high performance bench and system meters. Includes 5700A interconnect cable. For complete specifications, ask for Fluke document A0296.

74XXX-900 Bar-Code Reader. $1124
This selection adds the capability to read bar-coded property numbers directly. Streamlines identification of the unit to be tested and selection of the proper procedure. Includes an Intermec 9510 bar-code reader, 1260 Series wand with 10' coiled cord, power supply, manual and RS-232 cable.

74XXX-5450A Resistance Calibrator. $4880
Increases the best case resistance calibration accuracy of the system from 11 ppm to 7.5 ppm (±5°C, 90 days). Includes an IEEE-488 cable. For complete specifications, ask for Fluke document A0194.

74XXX-8842A Digital Multimeter. $1560
Adds 5$^1/_2$ digit DMM measurement capability to the system. Cannot be combined with the 74XXX-8506A DMM option described below. Includes a Fluke 8842A/059 with AC and IEEE-488 options, IEEE-488 cable and Y8077 low thermal four-wire short. For complete specifications, ask for Fluke document G0142.

7457A-5220A Transconductance Amplifier. $5930
For calibrating high current ranges of handheld and other meters. Boosts system current capability to 20A. Includes a Y5002 interface cable and 80J-10 10A current shunt. For complete specifications, ask for Fluke document A0075.

74XXX-8506A Digital Multimeter. $4195
Provides for high accuracy 6$^1/_2$ digit DMM measurement capability in the system. Can not be combined with the 74XXX-8842A DMM option described above. Includes an 8505A-02A ohms converter and IEEE-488 interface and cable. For complete specifications, ask for Fluke document number G0099.

Choose your packaging.

74XXX-014 Lab Cart. $506
A simple, inexpensive way to move your calibration system from place to place. This sturdy, open frame cart has 4" wheels and space for a calibrator, amplifier, controller, monitor and bar-code reader. Cannot accomodate 74XXX-5450A Resistance Calibrator, 74XXX-8842A DMM, 7457A-5220A Transconductance Amplifier or 74XXX-8506A DMM options due to a lack of room on the cart. Some assembly required.

Cluster. No packaging hardware is required.

7457A-136 36" Instrument Rack and Enclosure. $3985
Provides for complete mechanical integration of the 7457A system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, 3$^1/_2$" storage drawer and rack-mount kits for all 7457A options. Cannot accomodate the 74XXX-8506A DMM or 7457A-5220A Transconductance Amplifier options. See the 7457A-148 48" Instrument Rack and Enclosure described below.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

7457A-148 48" Instrument Rack and Enclosure. $4350
Provides for complete mechanical integration of the 7457A system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, 3$^1/_2$" storage drawer and rack-mount kits for all 7457A options. Rack-mount kit for the 74XXX-8506A DMM is included unless the 74XXX-8842A DMM is selected.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

Choose your support.

Extended Warranty. Extends the factory warranty to two years. Allows you to budget effectively for repair services and shortens turn-around time.

On-Site Repair Service. Convenient. Reduces system down time.

7411TAF Procedure Writing Training. $1250 per person
A five-day course that provides a comprehensive overview of 7411 Calibration Software and its applications in calibration systems. Held regularly at Fluke Service Centers.

Option. The course can be conducted on-site. Contact your local Fluke Sales office for more information on extended warranty, on-site repair and on-site warranty.

Artifact Calibration. Includes a 732A-100 10V Direct Voltage Reference Standard, 742A-1 Resistance Standard and 742A-10k 10k Resistance Standard to support the Artifact Calibration capability of the 5700A Calibrator. For more information on 5700A Artifact Calibration, ask for Fluke documents A0296 and B0175.

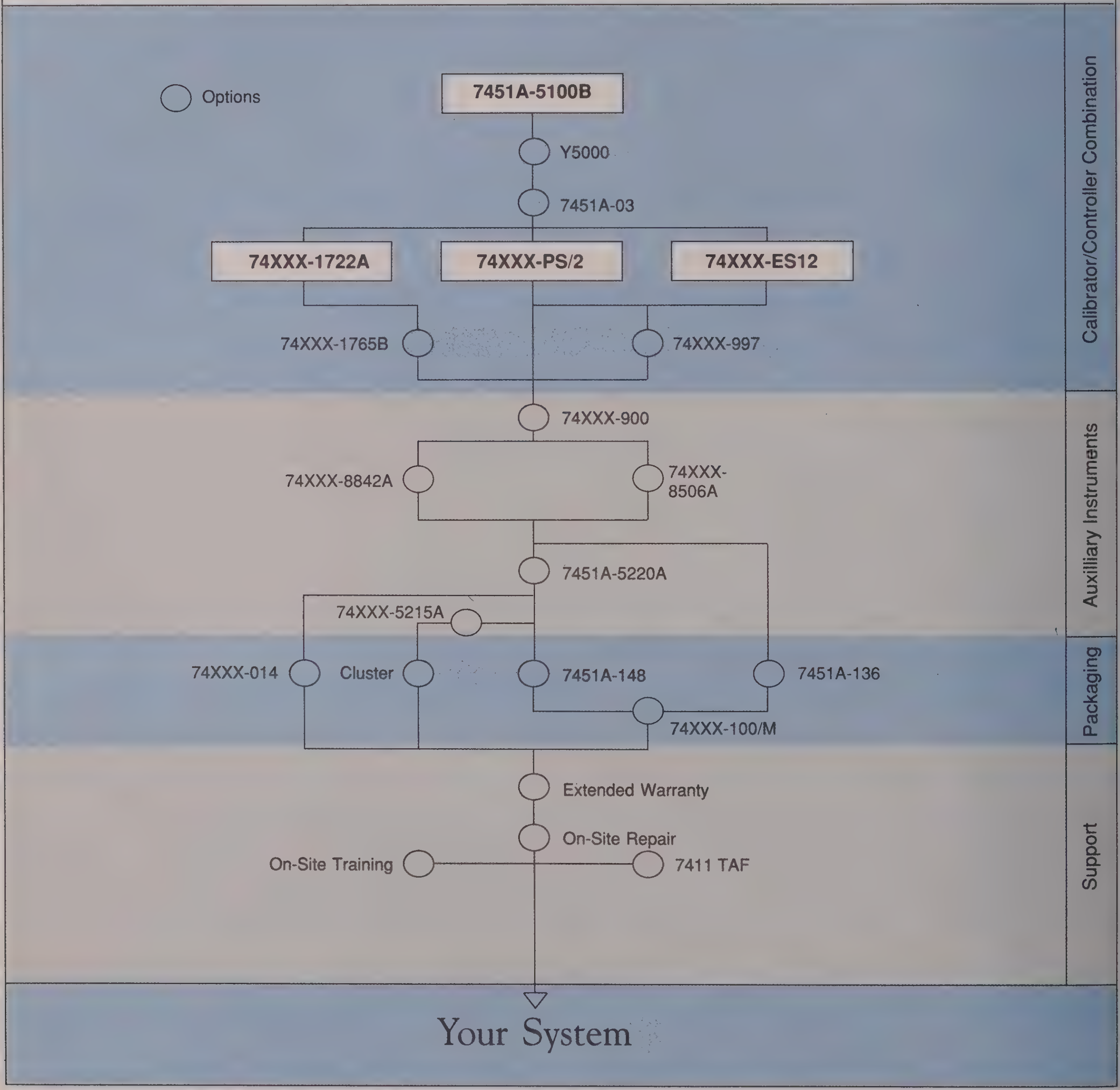
Refer to 732A and 742A sections of this catalog for more information.

7451A

GPIB IEEE-488

NEW

7451 Automated Calibration System



7451A Automated Meter Calibration Systems.

The 7451A system is designed to meet a large cross section of your meter calibration workload — medium accuracy instruments up to 4½ digits. With 8506A accuracy enhancement, it can address the 5½ digit portion of your workload as well. It is based on the Fluke 5100B Calibrator, the most widely used DMM calibrator in the world.

Select your calibrator.

7451A-5100B Calibrator. $12,230
Designed to cover calibration of meters of up to 4½ digits. Sources five functions: Direct voltage to 1100V. Alternating voltage to 1100V with frequencies from 50 Hz to 50 kHz. Resistance from 1Ω to 10 MΩ. Alternating and direct current to 2A. IEEE-488 cable is included. For complete specifications, ask for Fluke document A0295.

Y5000 Interface Buffer. $600
Required if 5215A or 5220A amplifiers are selected.

7451A-03 Wide Band Voltage Option. $3100
Extends the 5100B's frequency range to 10 Hz to 10 MHz to cover RF voltmeters.

Choose your system controller.

74XXX-1722A Touch Screen Instrument Controller. $10,875
Includes 7411C Software configured for your system. Easy re-configuration means you can add new instruments at any time. Also included: 1.0 Mbyte memory expansion. Two IEEE-488/RS-232 interfaces. Operators' aid. 400 kbyte 5¼" floppy disk drive. AC divider. IEEE-488 cable for unit under test (UUT) control.

Option. 74XXX-1765B 20 Mbyte Hard Disk Drive. $3,420
Increases storage capacity and system speed. Eliminates the need to use floppy disks for most operations. Includes IEEE-488 cable for connection to the 1722A.

74XXX-ES12 Controller. $12,616
This selection features the Hewlett-Packard Vectra Model ES12 configured as a system controller. Includes 7411PC Software configured for your system. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 12 MHz 80286 processor. 20 Mbyte hard disk drive. 640 kbyte RAM. Floppy and hard disk controller. Two RS-232 ports. Two parallel ports. One 1.2 Mbyte, 5¼" and one 360 kbyte 5¼" floppy disk drive. Two IEEE-488 control ports. DOS 3.3. HP EGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

74XXX-PS/2 Controller. $12,861
This selection features the IBM PS/2 Model 50 configured as an instrument controller. Includes 7411PC Software configured for your system. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 10 MHz 80286 processor. 20 Mbyte hard disk drive. 1 Mbyte RAM. Floppy and hard disk controller. Three RS-232 ports. One parallel port. Two 1.44 Mbyte, 3½" floppy disk drives. Two IEEE-488 control ports. DOS 3.3. IBM VGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

Choose your auxiliary instruments.

74XXX-900 Bar-Code Reader. $1124
This selection adds the capability to read bar-coded property numbers directly. Streamlines identification of the unit to be tested and selection of the proper procedure. Includes an Intermec 9510 bar code reader, 1260 Series wand with 10' coiled cord, power supply, manual and RS-232 cable.

74XXX-8842A Digital Multimeter. $1560
Adds 5½ digit DMM measurement capability to the system. Cannot be combined with the 74XXX-8506A DMM option described below. Includes a Fluke 8842A/059 with AC and IEEE-488 options, IEEE-488 cable and Y8077 low thermal four-wire short. For complete specifications, ask for Fluke document G0142.

74XXX-8506A Digital Multimeter. $4195
Broadens 5100B Calibrator's workload coverage to 5½ digit DMMs and provides for high accuracy 6½ and 7½ digit DMM measurement capability in the system. Can not be combined with the 74XXX-8842A DMM option described above. Includes an 8505A-02A ohms converter and IEEE-488 interface and cable. For complete specifications, ask for Fluke document number G0099.

7451A-5220A Transconductance Amplifier. $5920
For calibrating high current ranges of handheld and other meters. Boosts system current capability to 20A. Includes a Y5002 interface cable and 80J-10 10A current shunt. For complete specifications, ask for Fluke document A0075.

74XXX-5215A Voltage Amplifier. $10,025
Boosts the 5100B's alternating voltage capability to 1100V at 50 kHz to calibrate instruments that measure these high volt-Hertz levels. Includes Y5001 calibrator interface cable. Can only be selected for cluster systems.

Choose your packaging.

74XXX-014 Lab Cart. $506
A simple, inexpensive way to move your calibration system from place to place. This sturdy, open frame cart has 4" wheels and space for a calibrator, DMM, 5220A amplifier, controller, monitor and bar-code reader. Cannot accomodate the 74XXX-5215A Amplifier option due to a lack of room on the cart. Some assembly required.

Cluster. No packaging hardware is required.

7451A-136 36" Instrument Rack and Enclosure. $3985
Provides for complete mechanical integration of the 7451A system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, 3½" storage drawer and rack-mount kits for all 7451A options. Cannot accomodate the 7451A-5220A Transconductance Amplifier or 74XXX-5215A Amplifier options. See the 7451A-148 48" Instrument Rack and Enclosure described below.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

7451A-148 48" Instrument Rack and Enclosure. $4350
Provides for complete mechanical integration of the 7451A system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, 3½" storage drawer and rack-mount kits for all 7451A options. Rack-mount kit for the 74XXX-8506A DMM is included unless the 74XXX-8842A DMM is selected. 74XXX-5215A Amplifier option cannot be installed in this rack.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

Choose your support.

Extended Warranty. Extends the factory warranty to two years. Allows you to budget effectively for repair services and shortens turn-around time.

On-Site Repair Service. Convenient. Reduces system down time.

7411TAF Procedure Writing Training. $1,250 per person
A five-day course that provides a comprehensive overview of 7411 Calibration Software and its applications in calibration systems. Held regularly at Fluke Service Centers.

Option. The course can be conducted on-site.

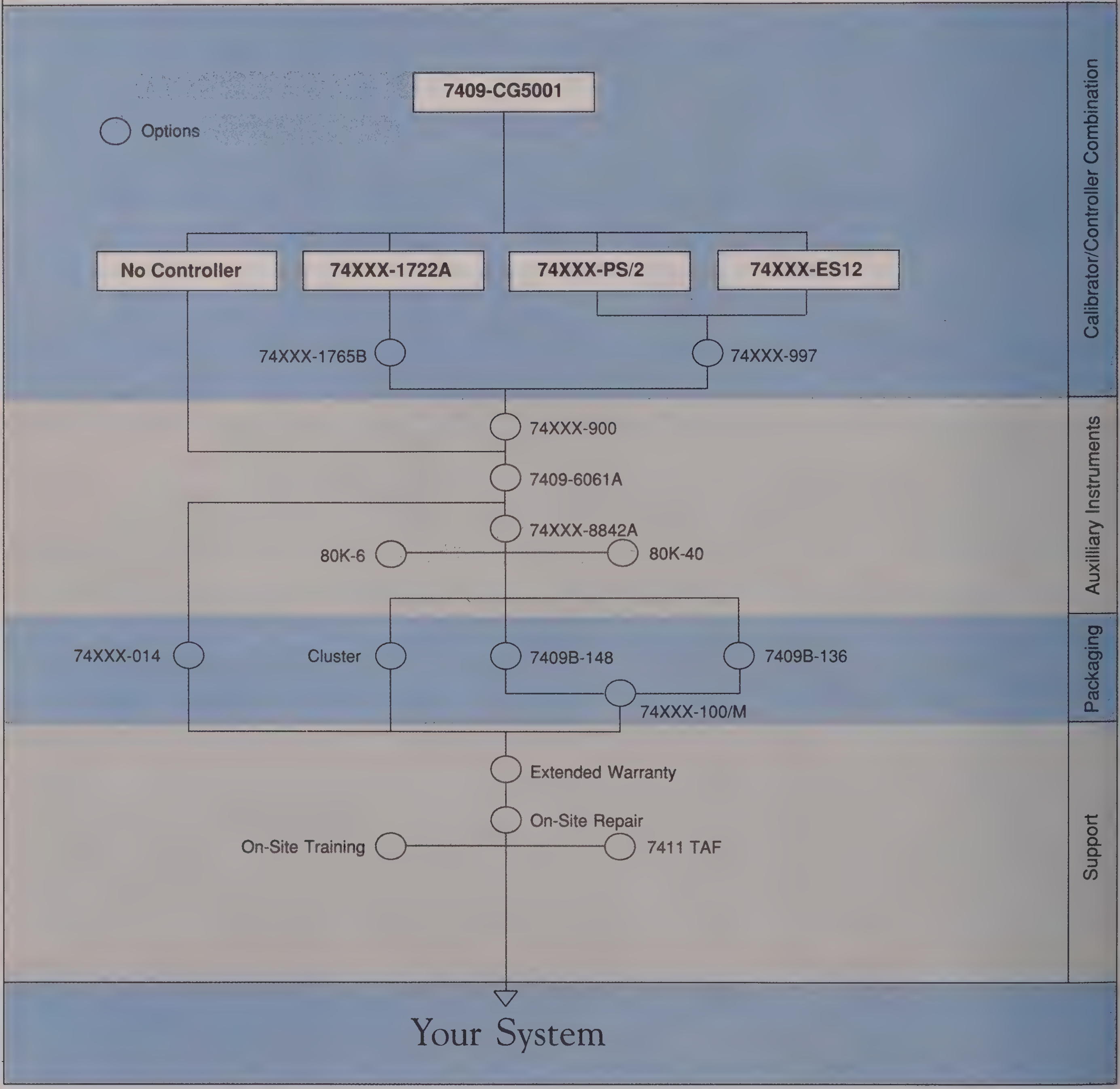
Contact your local Fluke Sales Office for more information on extended warranty, on-site repair and on-site warranty.

7409B

GPIB
IEEE-488

NEW

7409B Oscilloscope Calibration System



7409B Automated Oscilloscope Calibration System.

The 7409B system can be configured with its own controller to operate as a stand-alone analog oscilloscope calibration system. Or it can be ordered without a controller and operated as a supplement to a 7457A or 7451A meter calibration system.

Choose your calibrator.

7409B-CG5001 Oscilloscope Calibrator. $22,081
Verifies vertical gain, horizontal timing and gain, vertical pulse characteristics, probe accuracy and compensation, current probe accuracy and up to six functions for meter calibration.

Choose your controller.

No Controller. The 7409B system is controlled by the controller in a 7457A or 7451A meter calibration system.

74XXX-1722A Touch Screen Instrument Controller. $10,875
Includes 7411C Software configured for your system. Easy reconfiguration means you can add new instruments at any time. Also included: 1.0 Mbyte memory expansion. Two IEEE-488/RS-232 interfaces. Operators' Aid. 400 kbyte 5$^{1}/_{4}$" floppy disk drive. AC divider. IEEE-488 cable for unit under test (UUT) control.

Option. 74XXX-1765B 20 Mbyte Hard Disk Drive. $3420
Increases storage capacity and system speed. Eliminates the need to use floppy disks for most operations. Includes IEEE-488 cable for connection to the 1722A.

74XXX-ES12 Controller. $12,616
This selection features the Hewlett-Packard Vectra Model ES12 configured as a system controller. Includes 7411PC Software configured for your system. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 12 MHz 80286 processor. 20 Mbyte hard disk drive. 640 kbyte RAM. Floppy and hard disk controller. Two RS-232 ports. Two parallel ports. One 1.2 Mbyte, 5$^{1}/_{4}$" and one 360 kbyte 5$^{1}/_{4}$" floppy disk drive. Two IEEE-488 control ports. DOS 3.3. HP EGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

74XXX-PS/2 Controller. $12,861
This selection features the IBM PS/2 Model 50 configured as an instrument controller. Includes 7411PC Software configured for your system. Easy re-configuration means you can add new instruments at any time. The hardware configuration includes: 10 MHz 80286 processor. 20 Mbyte hard disk drive. 1 Mbyte RAM. Floppy and hard disk controller. Three RS-232 ports. One parallel port. Two 1.44 Mbyte, 3$^{1}/_{2}$" floppy disk drives. Two IEEE-488 control ports. DOS 3.3. IBM VGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

Choose your auxiliary instruments.

74XXX-900 Bar-Code Reader. $1124
This selection adds the capability to read bar-coded property numbers directly. Streamlines identification of the unit to be tested and selection of the proper procedure. Includes an Intermec 9510 bar code reader, 1260 Series wand with 10' coiled cord, power supply, manual and RS-232 cable.

7409B-6061A Synthesized RF Signal Generator. $6025
Provides an accurate amplitude signal from 10 kHz to 1.05 GHz for verifying oscilloscope bandwidth. Includes IEEE-488 cable.

74XXX-8842A Digital Multimeter. $1560
Adds 5$^{1}/_{2}$ digit DMM measurement capability to the system. Includes a Fluke 8842A/059 with AC and IEEE-488 options, IEEE-488 cable and Y8077 low thermal four-wire short. For complete specifications, ask for Fluke document G0142. 80K-6 High Voltage Probe. Extends the 8842A's voltage measurement capacity to 6000V. 80K-40 High Voltage Probe. Extends the 8842A's voltage measurement capacity to 40000V.

Choose your packaging.

74XXX-014 Lab Cart. $506
A simple, inexpensive way to move your calibration system from place to place. This sturdy, open frame cart has 4" wheels and space for a calibrator, signal generator controller, monitor and bar-code reader. Cannot accomodate the 74XXX-8842A DMM option due to a lack of room on the cart. Some assembly required.

Cluster. No packaging hardware is required.

7409B-136 36" Instrument Rack and Enclosure. $3985
Provides for complete mechanical integration of the 7409B system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, 3$^{1}/_{2}$" storage drawer and rack-mount kits for all 7409B options.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

7409B-148 48" Instrument Rack and Enclosure. $4350
Provides for complete mechanical integration of the 7409B system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, 3$^{1}/_{2}$" storage drawer and rack-mount kits for all 7409B options.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

Choose your support.

Extended Warranty. Extends the factory warranty to two years. Allows you to budget effectively for repair services and shortens turn-around time.

On-Site Repair Service. Convenient. Reduces system down time.

7411ATF Procedure Writing Training. $1,250 per person
A five-day course that provides a comprehensive overview of 7411 calibration software and its applications in calibration systems. Held regularly at Fluke Service Centers.

Option. The course can be conducted on-site.

Contact your local Fluke Sales office for more information on extended warranty, on-site repair and on-site warranty.

A123

GPIB IEEE-488

RS-232

Fluke Custom-Designed Automated Calibration Systems.

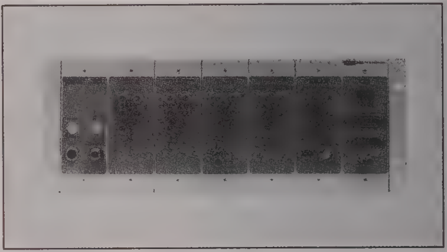
Flexibility is the key word for Fluke's custom automated calibration workstations. Now you can select the instrument combinations necessary to automate your calibration needs. Fluke offers a wide selection of both meter and oscilloscope calibration instruments which can be configured to satisfy your requirements and your budget. these workstations combine the accuracy of computer-aided calibration, the convenience of a test interface panel and the flexibility of customized configurations to meet a wide range of applciations. These workstations can be mounted in mobile racks to allow the calibrator to be easily transported to the work site.

Fluke will configure arrangements of various instruments. Contact your local Fluke Sales Representative for help in configuring a workstation.

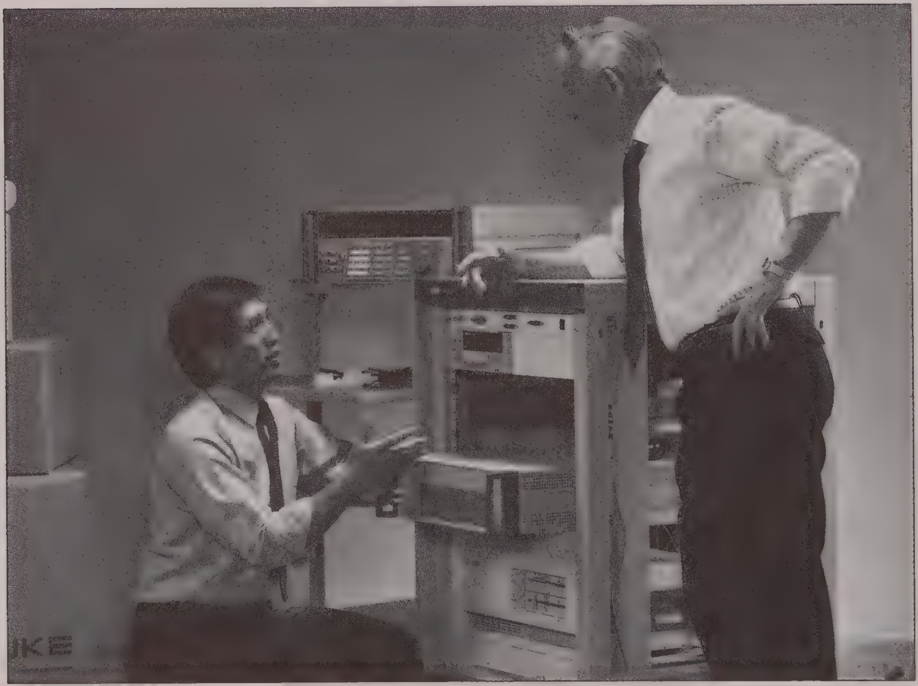
The Fluke A123 - Automated Meter Calibration Workstation

The Fluke A123 is a computer-aided automated calibration workstation which can be configured in a variety of ways to calibrate even the most accurate DMMs and oscilloscopes. All systems provide complete sourcing capabilities of direct volts, alternating volts, direct current, alternating current and resistance as well as measuring capability for direct volts, alternating volts, and resistance. Optional equipment can be added to extend the frequency range and also boost the alternating voltage output and current output.

The unit under test (UUT) is connected to the A123 through the Modular Test Interface Panel (MTIP). This provides all the connectors for the system instruments as well as the controller's data ports. The UUT can be connected to the 1722A's port for closed-loop calibration via the IEEE-488 bus. In this case, the operator simply starts the calibration test and the system digitally calibrates itself and the UUT.



Modular Test Interface Panel



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Specifications subject to change without notice. Some products and services may not be available outside the U.S. Contact your local Fluke or Philips representative for details.

Standards for Your Traceability Requirements

The best of instruments are only useful when you can depend on them to make accurate measurements. Fluke supports the accuracy of the instruments it sells through a line of calibration instruments and standards. Because these instruments have excellent short- and long-term stability, they are the ideal choice for transferring and maintaining electrical traceable units in your facility.

Two of the most recent additions to Fluke's line of standards are the 732A Direct Voltage Reference Standard and the 752A Reference Divider, developed to support the accuracy requirements of the 5440 Series Calibrators and Fluke's own Primary Standards Lab. These two standards make it possible for you to maintain direct voltage standards in your facility with accuracies not previously attainable outside a national laboratory. Also, an innovative calibration scheme, the Direct Voltage Maintenance Program, is operated by Fluke to make it possible for you to maintain this superb accuracy.

As Fluke continues to advance the state of the art in measurement and calibration, there will be a continuing need for better, more accurate, and more effective ways to assure your measurements are accurate. You can have complete confidence in Fluke's commitment to supporting existing and future instruments through effective standards and innovative, efficient methods for applying them to your needs.

aV Standards and Accessories

- 540B Thermal Transfer Standard
- 510A AC Reference Standard
- A40 and A40A Current Shunts
- A55 Thermal Converters

Resistance Standards

- 742A Resistor Standards

dV Standards and Accessories

- 732A dV Reference Standard
- Transport Case and Battery Charger for 732A
- Direct Voltage Maintenance Program
- 731B dV Reference Standard

Dividers, Lead Compensators, and Null Detectors

- 752A Reference Divider
- 750A Reference Divider
- 720A Kelvin-Varley Divider
- 721A Lead Compensator
- 845AB/AR Voltmeter/Null Detector

"Principles of Metrology" Course

The Fluke Principles of Metrology training course provides five days of intensive training for solving the problems of day to day cal lab operation. The course includes practical tips and exercises to illustrate:

- Loading errors
- Lead impedance
- Using voltage dividers
- Low level measurements
- Thermal EMFs
- Grounding and guarding

The course also includes in-depth discussions of traceability and measurement uncertainty, and general background information on the role of calibration and metrology. The course is designed to make your technicians more productive in calibrating test instrumentation. The student will begin to see and use creative techniques for specific measurement and calibration applications.

Traceability

Traceability means that there is a documentable link between the accuracy of an instrument and the highest level of standards as maintained by a national or international laboratory. The highest level of standards are referred to as legal standards. This means that they are recognized among several nations as being the standard of reference. The standards themselves may take the form of physical constants or natural phenomena, standard reference material, or proven ratio techniques.

Traceability requirements must be fulfilled in order for you to have confidence in your measuring instruments. Traceability requirements are often legal as well as practical requirements. You can think of traceability as the pedigree of measurement much like tracing the bloodline of champion animals. From a particular calibration job, each measurement can be traced all the way back to national standards. This trail of calibration is carefully recorded along with the details of the procedure. This typically includes the conditions of the test, the instruments used to make the calibration, and the time between calibrations.

742A

NEW

742A-1

742A-10k

742A Resistance Standards

- Small and rugged
- No oil or air baths required
- 18°C to 28°C operating range
- Supplied with temperature characterization
- Six month stability to 2.5 ppm

Fluke 742A Standard Resistors are high accuracy working standards for precision, on-site resistance calibration. Their excellent temperature stability allows them to be used from 18°C to 28°C with typically less than 2 ppm degradation. Using the calibration table supplied with the standards, which lists corrections in 0.5°C increments, this uncertainty can be reduced to near zero. No cumbersome oil or air baths are required.

Because 742A Standard Resistors are small and rugged, they are easy to transport. Care has been taken to reduce resistance changes brought about by thermal and mechanical shock. Retrace (permanent shift in resistance) is typically less than 2 ppm after cycling between 0°C and 40°C.

A convenient transit case, designed to hold two standards, is available as an option.

Optional 742A-7002 transit case.

Specifications

Nominal Value:
742A-1: 1Ω ±2 ppm;
742A-10k: 10 kΩ ±2 ppm
Calibration Uncertainty at 23°C: ±1 ppm
Operating Temperature: 18°C - 28°C
Stability (6 months):
742A-1: 5 ppm; 742A-10k: 2.5 ppm
Stability (12 months):
742A-1: 8 ppm; 742A-10k: 4 ppm
Maximum Voltage:
742A-1: 0.5V; 742A-10k: 30V
Storage Temperature: 0°C - 40°C
Retrace (permanent change in R):
18°C to 28°C cycle: Negligible
0°C to 40°C cycle: <2 ppm
Report of Calibration: Table of resistor values for 18°C to 28°C in 0.5°C increments.
Size: 3.4 in H x 4.15 in W x 5 in D
Weight:
742A-1: 2 lbs.
742A-10k: 1.7 lbs.

Ordering Information

Models		January 1989 prices
742A-1	1Ω Resistance Standard	$795
742A-10k	10 kΩ Resistance Standard	695
742A-7002	742A Transit Case; holds two unit	195

(NSN 6625-01-175-1193) **732A**

732A dV Reference Standard
10V, 1V and 1.018V outputs
0.5 ppm stability per month
18°C to 28°C operation at full accuracy specs
Short circuit proof
Traceable calibration to NBS Fluke Direct Volts Maintenance Program
Line and rechargeable battery powered
12-hour battery life for calibration transfer

The Fluke 732A is a solid state, dV reference standard which provides significant performance improvements in stability, ruggedness, and transportability. Its 10V output offers better resolution, lower noise, and simpler operation than standard cells. The 732A also includes outputs of 1.0 and 1.018 volts.

The accuracy and stability of the 732A allows direct substitution for saturated standard cells in many aplications. Its stability of 0.5 ppm for 30 days provides the confidence necessary to calibrate high-performance instruments. In addition, the use of the 10V output as a primary reference standard means that the effects of thermal emfs and noise are reduced.

The 732A can be shorted, even for extended periods of time, without damage and recovers without loss of stability. The unit may be powered by line voltage or will operate 12 hours on its internal battery — even longer on external batteries. Either line power or the external battery may be removed without affecting the output.

Saturated standard cells are fragile and susceptible to shock and vibration during traveling. The 732A was designed for air or ground shipment with no special handling.

The internal oven has high thermal gain allowing full accuracy to be specified over an operating range of 23°C ±5°C. Therefore, this new reference standard may be used outside of the conventional standards laboratory environment in areas where saturated cells or other transfer standards would not be accurate.

The 732A dV Reference Standard was originally developed by Fluke to transfer the volt into our own manufacturing facility. The unprecedented success achieved by this effort led to the development of the 732A for the commercial market. Fluke has developed a worldwide network of regional support centers to provide calibration support for the 732A where local standards are not available. These centers maintain volt-transfer programs with the national standards laboratories.

Transport Case and Battery Charger

The 732A-7002 Transport Case is a rugged, fiberglass, foam-lined case capable of holding a 732A dV Reference Standard and a 732A-7003 Battery Charger, complete with up to four 732A-7005 Battery Packs. The extra battery capacity of four Battery Packs plus the heat-conserving insulation of the foam lined case will extend the off-line operating time of the 732A to about 72 hours.

The 732A-7003 Battery Charger is specially designed to hold and charge from one to four Battery Packs with the proper constant current, constant voltage cycle to avoid damage from over-charging. Fully discharged batteries are returned to approximately 95% charge in 24 hours. The charger provides the necessary isolation diodes and interconnections to provide the optimum charge to battery packs which may have unequal capacities or states of charge and to connect the batteries to the 732A dc power input connector.

Specifications

Technical Specifications

Absolute Uncertainty: The 732A is normally delivered without absolute uncertainty specifications because, to maintain calibration as a traceable standard, the 732A must continue to receive uninterrupted operating voltage from line power or from the self-contained batteries, which provide approximately 12 hours of off-line operation. The 732A is normally shipped from the factory with the battery switch turned off. Upon receipt, the 732A must be powered up and stabilized for 24 hours before calibration against traceable standards. The absolute un certainty specifications for the 732A must then relate to the uncertainty specifications of the traceable standards used for this calibration.

732A

For a certified calibration by the Fluke Standards Laboratory and shipment under power, refer to the 732A-000 and 732A-100 options described under the Direct Voltage Maintenance Program, next page.

These specifications include effects of line voltage variations of ±10% and assume the 732A has been continuously powered.

Stability: Parts per million, 18°C to 28°C

Output	30 Days	90 Days	6 Months	1 Year
10V	±0.5	±1.0	±1.5	±3.0
1.018V	±1.5	±4.0	±6.0	±12.0
1V	±1.5	±4.0	±6.0	±12.0

Temperature Coefficient: ±0.05 ppm per °C for 10V range, ±1.0 ppm per °C for 1V and 1.018V ranges, from 18°C to 0°C to or 28°C to 40°C

Output Adjustment: ±50 µV for 10V and 1.018V ranges, ±5 µV for 1.0V range

Output Impedance: 1 mΩ for 10V output, 1 kΩ for 1V and 1.018V outputs

Output Current: ≤12 mA at 10V output. Limited by 1 kΩ output impedance at 1V and 1.018V output

Output Protection: May be shorted indefinitely. Protected against high voltage input transients to 1100V

Load Regulation: ≤1.2 ppm at 10V output from 0 to 12 mA

Line Regulation: ≤0.05 ppm of output for ±10% line change

Output Noise: ≤1 µV rms at 10V output from 0.1 Hz to 10 Hz

**Note: See the Direct Voltage Maintenance Program description on page 231 for the improved specifications and traceability which can be obtained for the 732A.*

General Specifications (732A)

Temperature: 0°C to 40°C, operating; 0°C to 50°C, non-operating (with internal battery pack switched off

Relative Humidity: ≤95% to 30°C, ≤75% to 40°C, non-condensing

Altitude: ≤3050m (10,000 ft) operating

Vibration: Per MIL-T-28800, Type III, Class 5, Style E

Safety: IEC 348, 2nd edition, 1978 and ANSI C39.5, 1980

Power: 100V, 120V, 220V, or 240V ac ±10%, 50 to 400 Hz or 24 to 30V ac 50 to 60 Hz. Also external 24 to 40V dc. Internal 24-V lead acid, gelled electrolyte battery operates for 12 hours at 23°C when fully charged. Trickle-charged continually when external power is applied

Size: 19.1 cm H x 22.1 cm W x 60.3 cm D (7.53 in x 8.69 in x 23.75 in)

Weight: 12.3 kg (27 lb)

Included: Instruction manual, line cord, adjustment tool and one 732A-7003 Battery Pack

732A-7002 Transport Case

Size: 77 cm x 61 cm x 31 cm (30 in x 24 in x 12 in)

Weight: 12 kg (26 lb)

732A-7003 Battery Charger

Input Power: 100V, 110V, 115V, 120V, 200V, 220V, 230V, or 240V ac 10%, 50 to 400 Hz, 100W max

Size: 61 cm x 19 cm x 22 cm (24 in x 8 in x 9 in)

Weight: 5.9 kg (13 lb) alone; 23 kg (50 lb) when equipped with four battery packs (732A-7005)

Ordering Information

Models

January 1989 prices

732A DC Reference Standard	$3800
732A-000* w/Special Calibration, shipped hot**	4040
732A-100* w/Special Calibration and Drift Certification, shipped hot**	4245

** See page 231 for description*
*** Under power*

Accessories (Also see page 485)

732A-7002 Transit Case	625
732A-7003 Battery Charger and Auxiliary Battery Case	1465
732A-7004 Rack Shelf (Holds 2 732As or 732A and 752A)	340
732A-7005 Replacement Battery Pack	375
5440A-7002 Low Thermal Copper EMF Plug-in Cables	350
845AB Voltmeter/Null Detector w/battery	2490
845AR Voltmeter/Null Detector w/rack mount	2350

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-732A Repair (w/calibration)	210
SC2-732A Cal	182

Direct Voltage Maintenance Program

- Volt traceability for your calibration laboratory with significant cost reductions over direct NBS calibration
- Uncertainty within a few tenths of a ppm
- Complies with MIL-STD-45662
- Avoid investing in redundant hardware: equipment never needs to leave laboratory
- No possibility of accidental loading and destruction as with saturated standard cells

Built around the 732A Direct Voltage Reference Standard, the Fluke Direct Voltage Maintenance Program (DVMP) provides state-of-the-art uncertainty for your own laboratory, traceable to the U.S. National Bureau of Standards (NBS). The 732A is a solid-state direct voltage reference standard which enables voltage transfers with uncertainties of only a few tenths of a ppm, while meeting the requirements for ruggedness and a range of operating temperatures. This level of performance is made possible by the low, predictable drift rate, allowing accurate extrapolation of the output voltage to be made over long time intervals. With the DVMP, dissemination of the legal volt can be easily accomplished with an uncertainty of less than one ppm.

Traceability

Traceability to the legal volt is the principle objective of the DVMP. The Fluke Primary Standards Laboratory in Everett, Washington (U.S.A.) maintains traceability to NBS and other national standards laboratories at the 10 volt level. Fluke establishes a "Traceability Plane" for you consisting of the mean (average) of the reference voltages maintained by your participating laboratories.

Four Services, Six Options to Choose From

The Fluke Direct Voltage Maintenance Program consists of four calibration services, resulting in six possible options, which can be used separately or in combination, depending on your needs. Two of the services are calibrations, performed completely by Fluke personnel, in the Fluke Standards Lab. These calibrations may be ordered as an option on a new 732A or as an option to be added to a 732A purchased previously. The other two calibration services are performed by the user, using a Fluke-owned standard, at the user's site, with the data transmitted to the Fluke Standards Lab for reduction and analysis. Complete description of the options follows:

1. **Option 732A-000.** Order this option to have an output voltage calibration performed on a newly ordered 732A. Before shipment, your new 732A will be compared to the direct voltage standards maintained in the Fluke Primary Standards Laboratory which are regularly compared to the Legal Voltage Standards maintained by the U.S. National Bureau of Standards. A report of calibration, listing the deviation from the nominal and the uncertainty of calibration is delivered with the instrument. The instrument will be delivered under power from self-contained and auxiliary batteries to insure the calibration.
2. **Option 732A-000R.** This is the option to order for calibration or re-calibration of a 732A purchased previously. Your 732A, when returned to the factory, will receive the same calibration as detailed under 732A-000 above, and will be returned to you under power.
3. **Option 732A-100.** Order this option to have a new instrument calibration for output voltage and characterized for drift rate before shipment from the factory. Your new 732A will be tested for both output voltage and drift rate by comparison against traceable standards for a period of 60 days in the Fluke Primary Standards Laboratory. Knowing the drift rate, the total uncertainty as a function of time is much reduced. A report of calibration, listing output voltage, drift rate, and uncertainties is delivered with the instrument which is delivered under power.
4. **Option 732A-100R.** This is the option to order for output voltage calibration and drift rate testing of a 732A purchased previously. Your 732A, when returned to the factory, will receive the same calibration and 60 day drift rate characterization as detailed under 732A-100 above, and will be returned to you under power.
5. **Option 732A-200.** This is the option to order for calibration of your 732A in your own laboratory. A Fluke-owned, calibrated 732A, together with all necessary connecting cables and clear operating instructions, will be sent to your site for comparison with your reference standard. A series of readings you make over a period of five days is recorded and returned to Fluke for evaluation at the Fluke Primary Standards Laboratory. A value is then assigned to your 10 volt standard, relative to the legal volt, and a report of calibration is returned to you. The quoted price for the 732A-200 option includes the shipping costs for the Fluke-owned 732A.
6. **Option 732A-201.** If you have more than one 732A in your lab, this is the option to order for calibration of each additional reference at the same site (must be ordered with Option 732A-200). Data collected by the user will be reduced and evaluated by the Fluke Standards Lab, and a report of calibration issued for the reference standard.

Specifications

Option Number	Calibration Uncertainty (CU)*	Drift Rate Uncertainty (DU)**			Total Uncertainty
		30 Days	90 Days	1 Year	
732A-000	0.6 ppm	0.5 ppm	1.0 ppm	3.0 ppm	$\sqrt{[(CU)^{2+} + (DU)^{2}]}$
732A-100	0.6 ppm	0.35 ppm	0.5 ppm	1.5 ppm	
732A-200	0.6 ppm	**	**	**	

* *Typical 99% confidence level; actual uncertainties determined at the time of test*

** *Drift rate uncertainty will be established with repeated participation in the DVMP*

How To Order

Note: At the present time, due to the difficulty in making timed shipment to international customers, calibration services requiring under power shipment are only available in selected countries.

It is important to recognize that proper timing and coordination of the activities between Fluke and your firm are essential to successful delivery of a 732A under power. Following receipt of an order for one of the DVMP services, you will be contacted directly by Fluke factory personnel. For this reason the following information must be included with each order:

- The option number ordered.
- If options 732A-000R or 732A-100R are ordered, include the serial number of the instrument to be returned to Fluke for the service.
- The exact address where the shipment will be received.
- The name and telephone number of the person who will be responsible for receiving the shipment and connecting it to the power line when it arrives.
- The name and telephone number of an alternate responsible person if the first designated individual is unavailable.
- Any restrictions on hours of the day during which receiving can take place.
- Fluke guarantees arrival of the instrument under power. If it is delayed, Fluke or the carrier will pay the shipping charges for return of the instrument to Fluke for recalibration.

Ordering Information

Models

Models	January 1989 prices
732A-000 New 732A w/Special Cal, shipped under power	$4040
732A-000R Special Calibration, shipped under power	295
732A-100 New 732A w/Cal, shipped under power	4245
732A-100R Calibration, Drift Certification, shipped under power	550
732A-200 On-Site 10V Certification w/Fluke Standard (includes shipping charges)	495
732A-201 Certification of Additional Reference/Same Site	125

Test Uncertainty Ratio

If you talk with metrologists long enough, inevitably you will hear a spirited discussion about just how accurate calibration equipment needs to be. A common measure of th relationship between the accuracy of the tester and the unit-under-test uncertainty ratio (TUR). (You also may have heard the term test accuracy ratio, but undertainty is the correct term for the small deviations from ideal behavior being described.) Simply defined:

$$\text{TUR} = \frac{\text{Uncertainty of Unit Under Calibration}}{\text{Uncertainty of the Calibrator}}$$

For many low-accuracy instruments, a common rule of thumb is a TUR of 10 or higher. For higher accuracy instruments, standards may not be available that are 10 times more accurate, so a figure of TUR = 4 frequently is used. Finally, when computing the buildup of errors in a traceable chain of standards from the national standards lab (such as the NBS), TURs typically are not used at all.

What is happening? To understand, it is useful to consider the statistical nature of the inaccuracy of an instrument. Consider the undertainty of a voltmeter's measurement of 10V dc. A curve can be used to describe the probability of a given uncertainty. A typical modern DMM with numerous, independent sources of error might have the "bell-shaped" normal distribution. The manufacturer's spec is an educated prediction which most instruments will meet under a given set of time, temperature and other environmental conditions. Fluke's goal, for a typical multimeter, is that 99.7 percent of the errors will fall within spec (±3 standard deviations).

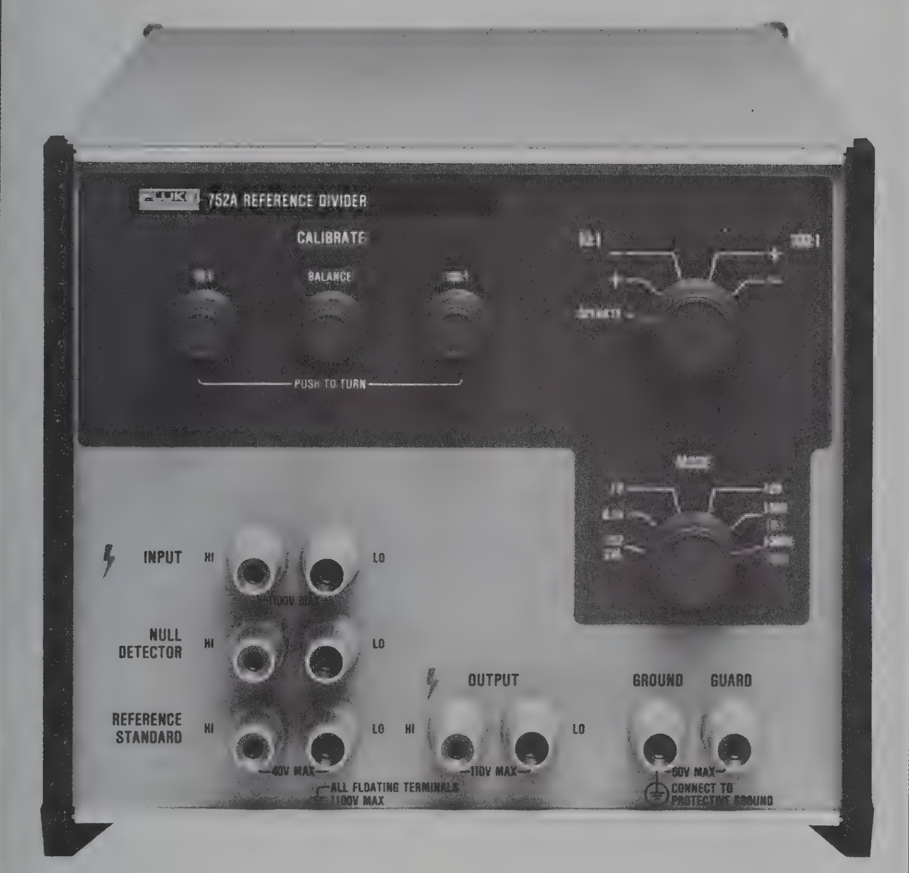
For traceable calibration, we must add the uncertainty of the calibration source to the relative DMM uncertainty to calculate absolute uncertainty. The figure shows the probable errors of the calibration. After calibration, the DMM error curve will be slightly broader as a result of calibrator error. The errors of the two instruments may be added directly, however, because of their statistical and independent nature. they add in root-sum-squares (rss) fashion:

$$E_{total} = \sqrt{(E_{dmm})^2 + (E_{cal})^2}$$

If the DMM error spec is 10 ppm and the calibrator error spec is 2.5 ppm, the total error spec after calibration will be 10.31 ppm. If the calibrator was as accurate as 1 ppm, th resultant DMM spec would be 10.05 ppm. In other words, if we are using a spec of 10 ppm for the DMM, after calibration the chance of being within spec only drops from 99.7 percent to 99.64 percent for 2.5 ppm calibration. The change is about .01 percent for the 1 ppm calibration.

And when should TURs never be used? Normally, when basic standard values, such as the volt, are transferred from the NBS down through the chain of standards labs, most metrologists track each separate source of error and add it to the previous total. The additions would be statistical for uncorrelated errors, so rss sums are used frequently. More conservative metrologists use only linear addition of error terms, which results in larger error factors and a better chance of being correct. It all depends on what needs are being satisfied, which is probably why, if you talk with a group of metrologists long enough, you will hear a spirited discussion.

752A



(NSN 6625-01-175-1192) **752A**

752A Reference Divider

- 10:1 and 100:1 division ratios
- Ratio accuracy of 0.2 ppm on 10:1 ratio
- Ratio accuracy of 0.5 ppm on 100:1 ratio
- Built in calibration bridge

The Fluke 752A Reference Divider sets new standards for direct voltage ratio accuracy and ease of use. It offers two divider outputs, 10:1 and 100:1 with output uncertainties of less than 0.2 ppm and 0.5 ppm respectively.

Before each use, the 752A is easily calibrated with only a stable voltage source and null detector like the Fluke 845AB or 845AR. The entire procedure requires only five minutes and does not require external standards.

The 752A also includes internal switching for calibrating the 100 mV, 1V, 10V, 100V, and 1000V ranges of a voltage calibrator to a 10V reference source (such as the Fluke 732A dV Reference Standard) without having to change the lead connections. It provides the voltage division capability required to calibrate state- of-the-art calibrators and similar instruments.

A "self-calibration" procedure allows you to compensate for long term changes in value of the divider resistors by switching their positions in various Wheatstone bridge configurations and using the BALANCE pot on the front panel.

Specifications

These specifications apply for the lifetime of the instrument over the temperature range of 18°C to 28°C.

Ratio Ranges: 10:1 and 100:1

Ratio Accuracy: The following table specifies the ratio accuracies of the 752A that apply for a temperature variation of less than ±1°C from the self-calibration temperature (between 18°C and 28°C) for up to 8 hours following self-calibration.

Range	Input Voltage	Output Uncertainty	Null Accuracy*
10:0	0 to 100V	0.2 ppm	±0.5 µV
100:1	0 to 1000V	0.5 ppm	±1.0 µV

**Null accuracy refers to the required accuracy of the null detector reading during self-calibration*

Temperature Coefficient: 1±1 ppm per °C over range of 18°C to 28°C. Typically 0.1 ppm per °C from 15°C to 30°C

Input Resistance:

10:1 Ratio: 380 kΩ ±1%

100:1 Ratio: Divider is 4 MΩ Driven Guard is 4 MΩ; total is 2 MΩ ±1%

Maximum Input Voltage: 200V for the 10:1 ratio; 1100V for the 100:1 ratio

Power Coefficient: ≤0.05 ppm of output with 100V applied for 10:1 ratio and ≤0.3 ppm of output with 1000V applied for 100:1 ratio (included in the ratio accuracy specifications)

Temperature: 0°C to 50°C, operating; -40°C to 75°C non-operating

Relative Humidity: ≤75% to 40°C, ≤45% to 50°C, non-condensing, operating <100% 10-50°C, non operating

Altitude: ≤3050m (10,000 ft) operating; ≤12,200m (40,000 ft) non-operating

Vibration: Per MIL-T-28800C, Type III, Class 5, Style E

Safety: IEC 348, 2nd edition, 1978; ANSI-C39.5, 1980

Size: 19.1 cm H x 22.1 cm W x 60.3 cm L (7.53 in x 8.69 in x 23.75)

Weight: 8.4 kg (18.5 lb)

Included: Instruction manual

Ordering Information

Models

January 1989 prices

752A Reference Divider	$5190

Accessories (Also see page 485)

5440A-7002 Low Thermal Copper EMF Plug-in Cables	350
845AB Voltmeter/Null Detector w/battery pack	2490
845AR Voltmeter/Null Detector w/rack mount	2350

540B

(NSN 6625-00-288-0184) **540B**

540B Thermal Transfer Standard

- 100 ppm aV/dV transfer uncertainty
- Less than 100 ppm dc reversal error
- Frequency range 5 Hz-1 MHz (to 50 MHz with A55)
- Overvoltage protection
- Polarity reversal switch

The Fluke 540B is a thermal transfer instrument for precise measurement and calibration of alternating voltage and current. The 540B is designed for simple operation with positive protection from overloads. Voltage transfers may be made from 0.25V to 1000V rms in 14 ranges, with a frequency range from 5 Hz to 1 MHz. Each range maintains specified accuracy down to half of range. Resolution of input per scale division varies from 12 ppm at full range to 60 ppm at half of range. Basic aV to dV transfer uncertainty is 100 ppm (±0.01%) without the use of calibration curves or correction tables.

The thermal element in the 540B is a specially constructed vacuum thermocouple protected from overvoltage. Up to 1500V dc or rms ac may be applied on any range without damage. A pushbutton protection disable switch allows confirmation that diode aging in protection circuitry is not contributing to error.

Three galvanometer sensitivity settings are provided. A sensitivity test fundtion provides momentary galvanometer deflection for 0.1% and 0.01% of input voltage, at any galvanometer sensitivity setting.

The 540B includes a meter-display search function, for continuous visual indication of input percent of range. The search function indicates when the overload circuit has activated, by deflecting upscale into a red "overload" area. After an overload condition, the 540B is returned to normal operation simply by setting the mode switch to "off."

The basis of transfer comparison in the 540B is always 1:1; ac and dc voltages are placed across the same transfer circuit. In this way, accuracy is independent of range division ratios.

Dc reversal error in the thermocouple is less than 100 ppm (0.01% of input voltage. A convenient "push-to-reverse" switch is provided to reverse dc input polarity.

A high frequency thermal converter input jack is provided so Ithat the galvanometer and Lindeck reference supply may be used with Fluke Model A55 High Frequency Thermal Converters.

The 540B operates from rechargeable nickel-cadmium battery cells for complete isolation from line power. Fully charged, the 540B may be operated for up to 200 hours without an interuption for charging.

Calibration

Each range is adjusted to be within the specified deviations from zero error as defined by reference standards maintained by the Fluke Standards Laboratory and periodically calibrated by the U.S. National Bureau of Standards. These ac/dc difference figures do not include U.S. National Bureau of Standards' random and systematic errors. Fluke test reports to the nearest 100 ppm are aviliable at extra cost upon request.

Characterization

Model 540B-900 is a 72-point characterization of a new 540B Thermal Transfer Standard. Model 540B-901 is the same characterization service for a customer-owned 540B, available through Fluke Technical Service Centers. All characterizations are actually performed by the John Fluke Standard Laboratory in Everett, Washington. This 72-point characterization is intended to support customers who wish to characterize 5200A-800 Enhancement Software.

Special characterizations to meet specific calibration requirements are also available. Consult your local Fluke Sales Office for further information.

Specifications

Voltage Ranges: 0.5, 1, 2, 3, 5, 10,20,30,50,100, 200, 300, 400, and 1000V, with each range usable from 1/2 to 1 times rating

aV to dV Transfer Uncertainty

Frequency	Voltage Ranges			
Hz	0.5-10V	10-50V	100-500V	1000V
5-20k	±0.01%	±0.01%	±0.01%	±0.02
20k-50k	±0.01%	±0.01%	±0.01%	±0.04%
50k-100k	±0.5%	±0.05%	±0.20%	X
100k-500k	±0.10%	±0.10%	X	X
500-1M	±0.10%	X	X	X

Search Function: Meter display of input as percentage of range
Input Impedance: 180Ω/V
Polarity: Reversible, front panel push-button
Galvanometer: Fluke electronic type
Galvanometer Resolution: 12 ppm of input/scale division at full range; 60 ppm of input/scale division at half range
Thermocouple Reversal Error: ≤100 ppm of input at full range; ≤300 ppm at half range
Overload Protection: Withstands up to 1500V dc or rms ac, any range
Power: 115V or 230V ac ±10%, 50 to 440 Hz, 7W; self-contained rechargeable batteries; 200 hours operation, 16 hours recharge time
Size: 17.2 cm H x 41.7 cm W x 19 cm D (in H x 17 in W x 7.75 in D)
Included: Instruction manual, A55 connecting cable

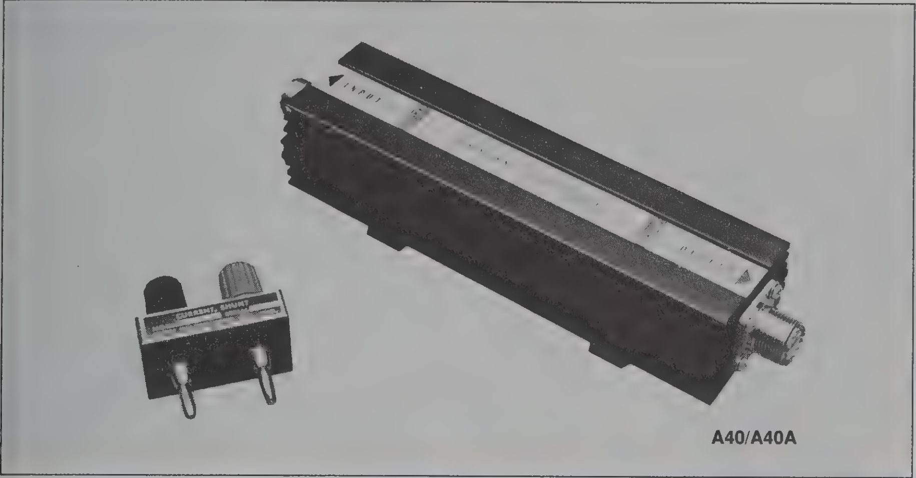
Ordering Information

Model

Model	January 1989 prices
540B Thermal Transfer Standard	$5900

Accessories

540B-103 7" Rack Adapter	130
540B-110 Rechargeable Battery Pack (retrofit kit)	475
A40 Current Shunts	630
A40A Current Shunts	700
A55 High Frequency Thermal Converters	735



A40/A40A

A40 and A40A Current Shunts

- Ac current transfer measurements form 2.5 mA to 20a
- Frequency response from 5 Hz to 100 kHz
- Designed for use with Model 540B

Models A40 and A40A Current Shunts make possible accurate ac to dc current transfer measurements using the Model 540B Thermal Transfer Standard and a known dc source. Measurements may be made over a 2.5 milliampere to 20 ampere range with a frequency response from 5 Hz to 50 kHz. Measurements to 100 kHz may be made up to 5 amperes.

Twelve A40 Current shunts are available with current ratings from 10 milliamperes to 5 amperes. A40A shunts are availbel with current ratings of 10 and 20 amperes. Each shunt maintains specified accuracy down to half its rated current level. With no shunt in place, the 540B may be used directly ofr current transfer measurements from 2.5 milliamperes to 5 milliamperes.

A40 shunts plug into panel connectors on the 540B. A40A shunts require special cables, available separately.

Calibration

All ac to dc differences expressed in the specifications are deviations from dc standards maintained by the U.S. National Bureau of Standards, and may be obtained without the used of calibration curves or correction tables. When properly used with a Fluke 540B Thermal Transfer Standard, wach A40 and A40A Current Shunt is within the specified deviation from zero error, as defined by reference standards maintained by the John Fluke Standards Laboratory and periodically calibrated by the U.S. National Bureau of Standards. These ac to dc difference figures do not include U.S. National Bureau of Standards random and systematic errors. Fluke test reports to the nearest 100 ppm (0.01%) are available at extra cost upon request.

Specifications

A40 Current Ratings: 10, 20, 30, 50, 100, 200, 300, and 500 mA; 1, 2, 3, and 5A (RMS)
A40A Current Ratings: 10 and 20A (RMS)
Uncertainty

Frequency	AC to DC Difference	
	A40	A40A
5 Hz - 20 kHz	±0.02%	±0.03%
20 kHz - 50 kHz	±0.03%	±0.05%
50 kHz - 100 kHz	±0.05%	

Ordering Information

Models

January 1989 prices

A40* Current Shunts	$630
A40A* Current Shunts	700

Accessories (Also see page 485)

A45-4003 Input Cable for A40A Shunts	70
A45-4004 Output Cable for A40A Shunts	100
Y8133 Test Lead Kit for A40 Shunts	22
C41 Storage Cases	630

**National Stock Numbers are available for most A40 and A40A shunts. Contact your Fluke sales engineer for details.*

A55

A55 High Frequency Thermal Converters

Useable to 50 MHz

Designed for use with Model 540B

Model A55 Thermal Converters make possible accurate thermal-transfer aV to dV measurements form subaudio frequencies to the VHF region. The design is comparable to that of standards maintained by the U.S. National Bureau of Standards.

Designed for use with the Model 540B Thermal Transfer Standard, nine model A55 Thermal Transfer Standards are available to match each 540B voltage range from 0.5V to 50V. The 540B includes a compatible connector that bypasses its internal transfer circuit, kusing only the null detector and reference supply. Each A55 converter maintains specified accuracy down to half its rated voltage.

A specially constructed thermocouple, selected for frequency characteristics and low dV reversal error, is the thermally responsive element. Input voltage is applied directly across the thermocouple heater on the 0.5V model. For higher voltages, low termperature-coefficient coaxially mounted metal film series dropping resistors are used.

Certification

Each A55 converter includes a Fluke production test record of aV to dV differences at 1, 10, 20, and 30 MMHz. A55 converters rated below 20V also include a production test record of aV to dV difference at 50 MHz. Fluke test reports at other frequencies and voltages are available at extra cost upon reuqest. AV to dV differences are established to within ±100 ppm by comparison to Fluke standards that are periodically intercompared with the U.S. National Bureau of Standards.

Accessory Kit

The Model A55-110 Accessory Kit is recommended for use with A55 Thermal Converters in virtually any calibration or measurement setup. The kit includes:

- Coaxial tee for A55 inmput (GR type 874-TL).
- Three coaxial adapters for A55 input: UHF, BNC, and type N jack.
- Interconnecting coaxial cable, as cource to coaxial tee.

Specifications

Voltage Ratings: 0.5, 1, 2, 3, 5, 10, 20, 30 & 50V*
**Each converter is useable from 1/2 to 1 times its rated voltage (rms)*

Uncertainty:

Frequency	Calibration Uncertainty*	Typical aV to dV Difference
< 1 MHz		<±0.01%
1 MHz	±0.05%	±0.01%
10 MHz	±0.10%	±0.01%
20 MHz	±0.15%	±0.02%
30 MHz	±0.20%	±0.10%
50 MHz	±0.50%	±0.30%

** All calibration is referenced to center of GR 874-TL coaxial tee attached to converter input connector*
***50 MHz calibraiton available only for 0.5, 1, 2, 3, 5, and 10V converters*

Input Impedance: 200Ω/V, approximate
Output Voltage: 7 mV nominal, at rated input
Output Resistance: 8Ω
Reversal Error: <250 ppm (0.025%)
Input Connector: GR type 874-TL
Output Connector: Amphenol 80-PC2M (2-pin microphone)
Size and Weight

Converters	Diameter cm	Length cm	Weight kg
0.5V	3.5	8.4	28
1V, 2V	3.5	13.2	370
3V, 5V	3.5	16.5	430
10V, 20V	3.5	17.9	450
30V, 50V	3.5	17.9	450

Included: Instruction manual and certification

Ordering Information

Model

January 1989 prices

A55* High Frequency Thermal Converter	$735

**Order by voltage rating, eg: A-55 -05V. Prices are for each converter*

Accessories (Also see page 485)

A55-110 Accessory Kit	735
C55 Storage Case	630

Service & Support

Warranty

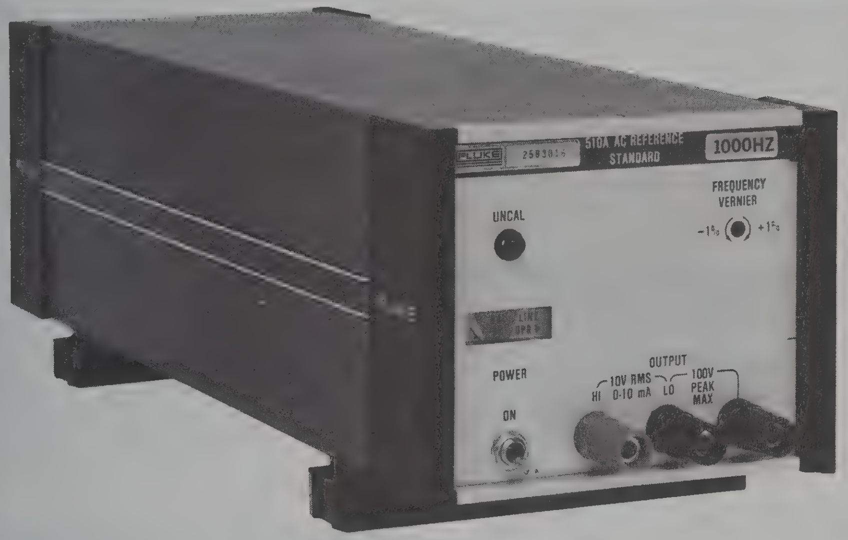
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-A55 Repair (w/calibration)	35
SC2-A55 Cal	135

**National Stock Numbers are available for most A55 Converters. See your Fluke sales engineer for details.*

510A



(NSN 6625-00-356-3085) **510A**

510A AC Reference Standard

- Uncertainty to ±100 ppm
- Optional battery operation
- Output voltage 10V rms
- Output current levels to 10 mA rms
- Fixed frequency, 50 Hz to 100 kHz

The 510A is a precision, fixed frequency, alternating voltage source designed for use as an amplitude calibration standard for test applications. In the calibration laboratory, the 510A provides an accurate aV reference for calibrating both true rms and average-sensing aV voltmeters. On the production line, the 510A can be used to rapidly verify aV test instrumentation or to generate a precise aV stimulus for circuit testing.

Output of the 510A is both fixed frequency and fixed amplitude. The frequency may be varied ±1% of center frequency with a front panel screwdriver adjustment.

Total harmonic distortion is less than 50 ppm up to 10 kHz, and less than 300 ppm at 10 kHz. This assures a pure sineware for calibrating average, peak, or true rms reading aV-to-dV converters.

The optional rechargeable battery pack provides up to 16 hours of operation independent of line power. A front panel display provides a continuous display of bettery condition. When operated from line power, the battery is maintained at full charge. The battery automatically operates the 510A whenever line power is removed.

Up to four 510As may be connected together for mounting in a standard rack. Output terminals are provided on both the front and rear panels for easy access in both bench and system applications.

Specifications

Technical Specifications

Output Voltage: 10V rms
Output Current: 10 mA rms, short-circuit protected
Frequency: Any specified single frequency from 50 Hz to 100 kHz Standard frequencies are: 50, 60, 400, 1000, 2400. 5000, 19,200, & 100,000 Hz
Amplitude Uncertainty:* ±ppm

Frequency	24 Hours	30 Days	90 Days
50 Hz-20 kHz	100	150	200
20 kHz-50 kHz	150	250	350
50 Hz-100 kHz	400	500	600

* *After 10-minute warm-up in ambient temperature 21°C to 25°C*

Amplitude Stability: ±ppm

Frequency	24 Hours	30 Days	90 Days
50 Hz-20 kHz	20	50	100
20 kHz-100 kHz	40	100	200

Total Harmonic Distortion: Less than 50 ppm to 10 kHz; less than 300 ppm at 100 kHz
Center Frequency Uncertainty: ±0.1%, adjustable ±1%
Frequency Stability: 500 ppm per mo
Load Regulation: ≤20 ppm to 10 kHz; ≤80 ppm at 100 kHz
Line Regulation: ≤10 ppm for ±10% line change
Input Power: 115 or 230V ac ±10%, 50 to 500 Hz, or optional rechargeable batteries
Size: 8.8 cm H x 10.7 cm W x 30.4 cm D (3.5 in H x 4.25 in W x 12 in D)
Weight: 2.26 kg (5 lb)
Included: Instruction Manual, power cord, calibration certificate

Ordering Information

Models

January 1989 prices

510A* AC Reference Standard	$1790
510A-01* AC Reference Standard w/battery pack	1995
510A/SF* AC Reference Standard (Special Frequency)	on req
510A-01K Rechargeable Battery Pack (for retrofit)	375

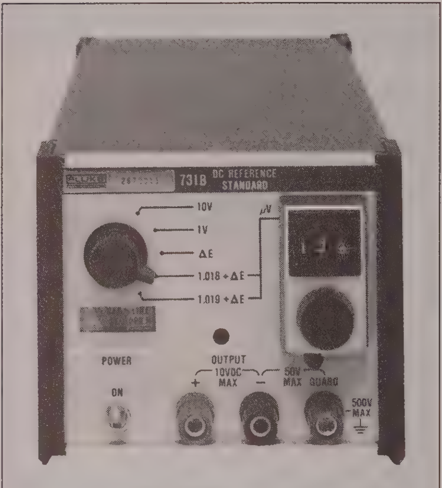
**Specify frequency when ordering*

Accessories (Also see page 485)

M03-201-601 Rack Mount Kit, Single	160
M03-202-603* Rack Mount Kit, Dual	110
M03-206-604* Rack Mount Kit, Triple	180
M03-205-605* Rack Mount Kit, Quad	105

**May be combined with the 731B*

731B & 721A



(NSN 6625-01-012-4638) **731B**

731B DV Reference Standard

- Outputs at 10, 1, 1.018, and delta E
- 10 ppm output accuracy
- Guarded floating output up to 500V above ground
- Line and battery powered

The Fluke Model 731B DC Reference Standard is a versatile instrument providing stability, while utilizing the excellent performance capabilities of solid-state technology. The instrument furnishes a variety of prevision voltages with switched output ranges including 1.0, 1.018 + ΔE, 10.0, and ΔE volts. Delta E (ΔE) provides a variable output of 0 through 999 μV which is either added to the voltage of a standard cell transfer or may be used directly as a low-level, stable direct voltage source.

Specifications

Output Ranges: 10V, 1V, 1.018 + ΔE, 1.019 + ΔE, ΔE

Output Accuracy:*

Range	30 Days	90 Days	1 Year
10V	±10 ppm	±15 ppm	±30 ppm
1V	±10 ppm	±15 ppm	±30 ppm
1.018+ΔE	±10 ppm	±15 ppm	±30 ppm
1.019+ΔE	±10 ppm	±15 ppm	±30 ppm
ΔE	—	—	±2 μV

**Absolute accuracy at 23°C ±1°C after 30 minutes warm-up*

Transfer Accuracy (Stability)

Between	4 Hours
Standard cells on 1.018V + ΔE ranges ranges or 1.019V + ΔE ranges	2 ppm
Standard cell and 1V output	3 ppm
10V output and standard cell or 1V output	5 ppm

Source Resistance: 10V range is <0.07Ω The 1V, 1.018V, 1.019V, and ΔE ranges are <1 kΩ

Output Protection: The output may be shorted indefinitely without damage to instrument

Line Regulation: <1 ppm for ±10% line voltage variation

Ripple & Noise: <1 ppm peak-to-peak 0 to 1 Hz, <20 μV rms 1 Hz to 1 MHz, except <70 μV rms at 10V output

Common Mode Noise Rejection: ≥120 dB at 0 Hz, ≥100 dB at 60 Hz, ≥85 dB at 400 Hz

Isolation: Output may be floated up to 500 dV between chassis ground and guard

Temperature: 0°C to 55°C, operating

Power: 115V or 230V ac ±10V, 50 to 400 Hz or internal rechargeable batteries, 6W max, 120 mA max

Size: 8.8 cm H x 10.7 cm W x 30.4 cm D (3.5 in x 4.5 x 12 in)

Weight: 2.26 kg (5 lb)

Included: Manual, power cord, batteries, serialized and dated calibration certificate

Ordering Information

Models

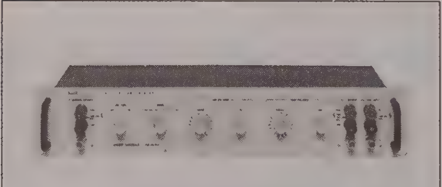
January 1989 prices

731B DC Reference Standard	$1850

Accessories

(Also see page 485)

M03-201-601 3" Rack Adapter, Single	160
M03-202-603 3" Rack Adapter, Dual	110
M03-206-604 3" Rack Adapter, Triple	180
M03-205-605 3" Rack Adapter, Quad	105



(NSN 6625-00-445-3330) **721A**

721A Lead Compensator

The 721A Lead Compensator equalizes the voltage drop across two resistive dividers connected in parallel for calibration. The errors due to contact and lead resistance are eliminated.

Specifications

Resolution of Resistance Compensation: 0.1 mΩ

Maximum Ratio Between Divider Resistance: 4000:1

Maximum Allowable Lead Resistance: 150 mΩ

Maximum Divider Voltage: 1500V dc

Size: 8.8 cm H x 48.2 cm W x 15.2 cm D (3 1/2 in x 19 in x 6 in)

Weight: 2.72 kg (6 lb)

Included: Manual

Ordering Information

Model

January 1989 prices

721A Lead Compensator	$1760

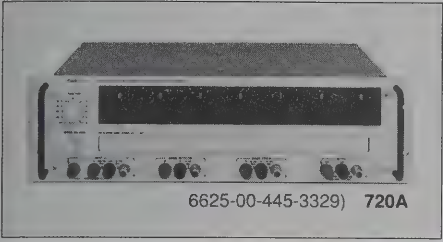
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions

Extended Warranty

SC1-721A Repair (w/calibration)	65
SC1-721A Repair (cal w/in or out data)	80
SC1-721A Repair (cal w/in and out data)	95
SC2-721A Cal	31
SC2-721A Cal (w/in or out data)	46
SC2-721A Cal (w/in & out data)	61



6625-00-445-3329) **720A**

720A Kelvin-Varley Divider

- 0.1 ppm resolution, seven decades
- 0.1 ppm of input absolute linearity
- Built-in self calibration bridge
- Front panel self calibration

Model 720A Kelvin-Varley Divider is a high-resolution primary ratio standard with absolute linearity of 0.1 ppm, temperature coefficient of linearity of 0.1 ppm/°C, and self-calibration capability.

Specifications

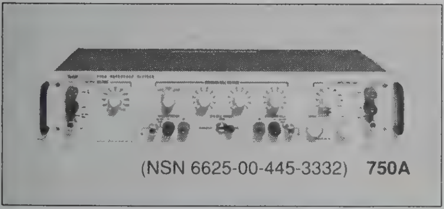
Ratio Range: 0 to 1.0 (1.0 input tap) and 0 to 1.1 (1.1 input tap)
Resolution: 0.1 ppm of input with seven decades
Absolute Linearity: (At calibration temperature and without the use of a correct chart) ±0.1 ppm of input at dial settings of 1.1 to 0.1, ±0.1 $(10S)^{1\ 3}$of input at dial settings (S) of 0.1 to 0
Absolute Linearity Stability: (Without self-calibration) ±1.0 ppm of input/yr at dial settings of 1.1 to 0.1, ±1.0 $(10S)^{2\ 3}$ ppm of input/yr at dial setting (S) of 0.1 to 0

NOTE: Absolute linearity is defined as the linearity between max and min output voltages. The self-calibration procedure may be used at any time to reset absolute linearity to ±0.1 ppm of input

Temperature Coefficient of Linearity: ±0.1 ppm of input/°C maximum at dial settings of 1.1 to 0.1
Short-Term Linearity Stability: Under typical conditions in a standards laboratory environment (temperature maintained within ±1 C) and with an applied voltage of up to 100V, stability of linearity is 0.1 ppm/30 days
Power Coefficient of Linearity: ±0.2 ppm of input/W max at dial settings of 1.1 to 0.1; ±0.2 $(10S)^2$ ppm of input/W max at dial settings (S) of 0.1 to 0
Maximum End Errors: Zero error at output low: 0.004 ppm of input. Zero error at input low: 0.05 ppm of input. Full-scale error: 0.05 ppm of input
Thermal Voltages: ±0.5 µV max
Maximum Input Voltage: 1000V on 1.0 input terminal, 1100V on 1.1 input terminal
Input Resistance: 100 kΩ ±0.005% at 1.0 input terminal at 25 C; 110 kΩ ±0.005% at 1.1 input terminal at 25 C
Temperature Coefficient of Input Resistance: ±1 ppm per C max
Size: 14 cm H x 48.2 cm W x 33 cm D. rack-mounted (5.5 in H x 19 in W x 13 in D)
Weight: 8.16 kg (18 lb)
Included: Manual

Ordering Information

Model	January 1989 prices
720A Kelvin-Varley Voltage Divider	$7290



(NSN 6625-00-445-3332) **750A**

750A Reference Divider

- 10 ppm basic division ratio accuracy
- Switched input and output ranges
- Built-in Kelvin-Varley Divider for standard cell reference
- Overvoltage protection to 2 kV, any range

Model 750A Reference Divider is an extremely accurate and stable voltage divider for calibration of precision meters, calibrators, etc. The instrument is a 10 ppm (0.001%) divider with switched input taps ranging from 1100 to 1.1V, and switched output taps ranging from 1100V to 0.1V.

Specifications

Input Voltages: (Switched) 1.1, 5, 10, 50, 100, 500, 1000, 1100V
Output Voltages: (Switched) 0.1, 0.5, 1, 1.1, 5, 10, 50, 100, 500, 1000, 1100V
Standardizing Output: 1.017000 to 1.019999 dV in 1 µV steps
Division Ratio Accuracy and Stability: (Referenced to Standard Cell tap) ±(0.001% of output +0.5 µV) for 1 year
Calibration: All ranges above 1.1V are adjustable ±10 ppm
Calibration Resolution: 0.2 ppm
Divider Current: 1 mA nominal
Input Current Adjust: Coarse and fine frontpanel rheostats provide an input voltage adjustment span of 10 mV with better than 1 µV resolution
Overvoltage Protection: Up to 2 kV may be applied on any range without damage
Power: Two 6.75V mercury batteries (1 year life)
Size: 8.8 cm H x 48.2 cm W x 33.0 cm D (3 in x 19 in x 13 in)
Weight: 7.25 kg (16 lb)

Ordering Information

Models	January 1989 prices
750A Reference Divider	$4990

Service & Support

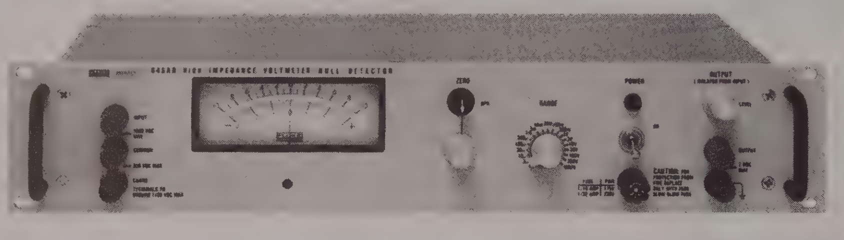
Warranty

One-year warranty. Calibration guaranteed during calibration cycle. (See page 470 for further information on warranty and calibration.)

Extended Warranty

SC2-720A Calibration	216
SC2-720A Calibration (w/incoming or outgoing data)	291
SC2-720A Calibration (w/incoming & outgoing data)	366

845AB & 845AR



(NSN 6625-00-257-7561) **845AR**

NSN 6625-00-226-3718 **845AB**

845AB & 845AR Null Detector

- 10 ranges from 1 µV through 1000V
- Input isolation greater than 10^{12} ohms
- Input may be floated to 1100V above ground
- Overload protected to 1100V on all ranges
- Recorder output isolated from input

The Fluke 845AB and 845AR are solid-state null detectors designed for extremely high input impedance, sensitivity, and isolation. Model 845AB operates either from the line or from built-in rechargeable batteries. Model 845AR is a line-powered rack-mounting version, with a height of 3 inches. Source loading through leakage is virtually eliminated by input isolation of 10^{12} ohms regardless of power line, chassis ground, or guard connections. Recorder output provides ±1V dc for end-scale deflection with ±0.5% linearity and does not affect input isolation. The 845AB and 845AR are capable of being floated up to 1100V dc from ground at either input terminal when used in a bridge circuit to compare voltage divider ratios. The unit with stands overloads up to 1100V dc on any range with a typical recovery time of four seconds.

Specifications

Range: 1 µV through 1000V dV end-scale in nineteen ranges, using 1, 3, 10 progression
Input Resistance: 100 MΩon 300 mV range and above. 10 MΩ on 3 mV through 100 mV range, 1 MΩ on 1 mV range and below
Accuracy: Model 845AB ±(2% end-scale +0.1 µV). Model 845AR ±(3% end-scale +0.1 µV)
Maximum P-P Meter Noise: 0.20 µV on 1 µV range, 0.25 µV on 3 µV range, 0.3 µV on 10 µV to 1000V range, with input shorted
Input Isolation: Better than 10^{12} ohms at ≤50% relative humidity and 25°C regardless of line, chassis, or recorder grounding. Better than 10^{10} ohms up to 80% relative humidity and 35°C. With driven guard, isolation improves to at least 10^{13} ohms. Either input terminal can be floated 1100V off chassis ground
DC Common Mode Rejection: Better than 160 dB, input short-circuited, ≤80% relative humidity; better than 140 dB, open-circuited, ≤50% relative humidity; better than 120 dB, open-circuited, ≤80% relative humidity
AC Common Mode Rejection: (Below 100 kHz) 100V rms or 120 dB greater than end-scale, whichever is less, will affect reading <2% of end-scale (input open-circuited)
AC Normal Mode Rejection: (60 Hz and above) ac voltages 60 dB above end-scale will affect reading <2% of end-scale. Maximum voltage not to exceed 750V rms
Recorder Output: ±1V dc at full scale deflection. Linearity, 0.5%. Output impedance, 5K to 7.5K. Recorder output is isolated from input and is referenced to ground
Stability of Zero: Better than 0.15 µV/hour; better than 0.3 µV/day
Overload Capability: Up to 1100V dc may be applied on any range. Typical recovery time is 4s
Power, Model 845AR: 115 or 230V ac ±10%, 50 to 440 Hz, approx. 3W
Power, Model 845AB: 115 or 230V ac ±10%, 50 to 440 Hz or rechargeable battery. Approximately 6W during recharge. 40 hr operation on full charge. Batteries trickle-charge while instrument operates from power line
Size, Model 845AB: 17.8 cm H x 21.6 cm W x 20.3 cm D (7 in H x 8.5 in W x 8 in D)
Size, Model 845AR: 8.9 cm H x 48.3 cm W x 21 cm D (3.5 in H x 19 in W x 8.25 in D)
Weight: Model 845AB: 4.65 kg (10.25 lb); Model 845AR: 4.08 kg (9 lb)

Ordering Information

Models

January 1989 prices

845AB Voltmeter/Null Detector w/batteries	$2490
845AR Voltmeter/Null Detector	2350

Accessories (Also see page 485)

881A-102 7" Rack Adapter, Single, for 845AB	175
881A-103 7" Rack Adapter, Dual, for 845AB	120
5440A-7002 Low Thermal Copper EMF Plug-in Cables	350

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-845AB/AR Repair (w/calibration)	130
SC1-845AB/AR Repair (cal w/in or out data)	165
SC1-845AB/AR Repair (cal w/in and out data)	200
SC2-845AB/AR Cal	50
SC2-845AB/AR Cal (w/in or out data)	85
SC2-845AB/AR Cal (w/in an out data	120

Limited Availability

7405A

7405A Multimeter Calibration Workstation

The 7405A is a fully automated, precision calibration workstation. It can rapidly and accurately calibrate a wide range of meters including DMMs, DVMs, VTVMs, and VOMs as well as voltage and current sources, power supplies, amplifiers, and passive devices.

A basic 7405A is comprised of a fully integrated group of Fluke measurement and calibration instruments - the 5100B Multifunction Calibrator, the 8505A Digital Multimeter, and the 1722A Instrument Controller - built into a console having a single unique Test Interface Panel. Switching circuitry in the test panel provides functional self tests. Innovative software combined with the test panel enhances the 7405A accuracy.

7410A Oscilloscope Calibration Workstation

The Fluke 7410A is a fully integrated, automated calibration workstation which rapidly and accurately calibrates oscilloscopes of any manufacturer. It also verfies and calibrates plug-ins, probes, amplifiers, calibration fixtures, and related devices. The 7410A can be customized by the user to accommodate additional workloads.

The Fluke 7410A combines the powerful 1722A Instrument Controller with the Tektronix CG5001 Programmable Calibration Generator and the Fluke 8520A DMM. Other Fluke instrumentation provides additional measurement and stimulus capability to address the bulk of scope workload.

Ordering Information

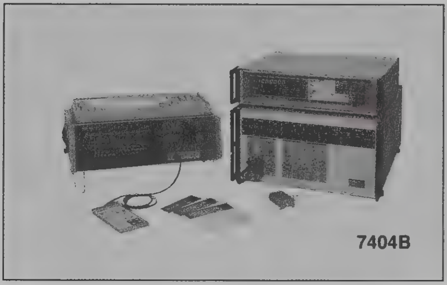
Model	January 1989 prices
7405A Automated Calibration Workstation NSN 6625-01-225-3251	$61,500

Options	
7405A-100 Precision Power Amplifier (req both -150 and -500 Options)	11,875
7405A-120 Transconductance Amplifier (req both -150 and -500 Options)	6,175
7405A-150 5100 Series Interface	650
7405A-200 Frequency Counter/Timer	3,075
7405A-500 Rack with Cabinet	4,395
7405A-501 Same as -500, but 230V version	on req
7400A-520 Controller Workstation	2,495

Model	January 1989 prices
7410A Automated Calibration Workstation	$63,412

Options	
7410A-211 w/6011A Signal Source	6600
7410A-260 w/6060B Signal Generator	6034
7410A-270 w/6070A Signal Source	18,645
7410/A-271 w/6071A Signal Source	21,995
80K-40 High Voltage Probe	85
7400A-520 Workstation Table	2495

Accessories	
Y1706 Pack of 10 Blank Disks	60


7404B

The 7404B Computer-Aided Calibration Cluster is an automated, highly accurate meter calibration system. It allows you to quickly and accurately calibrate digital and analog meters, power supplies, and other electronic instruments. The 7404B combines field-proven Fluke hardware and state-of-the-art 7411B Calibration Software in a system designed for reliability, durability, and performance that will meet your most stringent demands. Hardware combines the Fluke 5100B Multifunction Calibrator and 8506A Digital Multimeter under the control of the 1722A Instrument Contoller; the 1722A runs the 7411B Calibration Software.

Ordering Information

Model	January 1989 prices
7404B Computer-Aided Meter Calibration Cluster	$30,560

Options	
5100A-03 Wideband AC Voltage for 5100B & 5101B	on req
8505A-02A* Ohms Converter	550
8500A-03* Current Converter	550
5202A Precision Power Amplifier for aV and dV (requires Y5000 and Y5001 in 5100B)	on req
5215A Precision Power Amplifier for aV (requires Y5000 and Y5002 in 5100B)	on req
5220A Transconductance Amplifier (requires Y5000 and Y5002 in 5100B)	5,650
17XXA-008 IEEE-488/RS232C Interface for 1722A	850

**Cannot install both -02A and -03 in 8506A at the same time*

High Voltage Power Supplies

(NSN 4931-00-115-0567) **410B**

The 410B and 415B are extremely stable dc sources that cover the range of 0 to 10,000V with 5 mV resolution and 0.25% calibration accuracy. The 410B provides 0 to ±10,000V at 10 mA maximum output current. The 415B covers from 0 to ±3100V at 30 mA maximum. Both models include adjustable over-current protection.

410B High Voltage Power Supply	$5,450
415B High Voltage Power Supply	3,950

80E-10 High Voltage Divider

(NSN 6625-00-459-3219) **80E-10**

The 80E-10 is a voltage divider designed for use with voltmeters in measuring up to 10,000V dc. Divider outputs at 10V and 1V are proportional to 10 kV dc input and are accurate to ±0.01%. High measurement stability and accuracy are assured through the use of Fluke manufactured precision wire-wound resistors mounted on glass-epoxy printed circuit boards.

80E-10 High Voltage Divider	$1,325

(NSN 6625-00-492-5385) **7105A**

dV Calibration and Ratio System

- Cost-effective, high accuracy calibration
- Self-calibrating
- Expandable for aV calibration

The 7105A is a calibration system composed of five Fluke standards-type instruments mounted in a single benchtop cabinet. The 7105A is well known world-wide and is used extensively by electronic and electrical equipment manufacturers and government facilities.

Although the system is strictly for calibrating direct voltage sources, direct voltage meters, and the direct voltage value of resistors and dividers, the dV capabilities may be extended to aV calibration and measurement through the use of Fluke thermal transfer standards 540B, A55, A40, and A40A.

The instruments comprising the 7105A are:

Model 335A DC Voltage Standard/ Null Detector	$11,450
Model 845AR High Impedance Voltmeter/Null Detector	2,350
Model 750A Reference Divider	4,990
Model 720A Kelvin-Varley Divider	7,290
Model 721A Lead Compensator	1,760

Applications

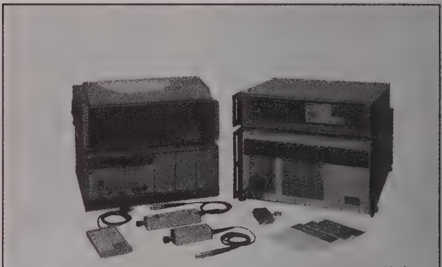
The 7105A can be used to calibrate dV calibrators and voltmeters to 0.5 ppm relative uncertainty. It can also be used to calibrate voltage dividers to 0.1 ppm of input total uncertainty. As a differential voltmeter, the 7105A can be used up to 0.5 ppm relative uncertainty and 0.1 ppm resolution.

Ordering Information

Models

January 1989 prices

7105A dV Calibration System (includes 7105A-502)	$27,870
7105A-502K Cabinet, w/gold flashed low, thermal leads, accessories, 115V	1,680
7105A/AA Cabinet, w/gold flashed low thermal leads, accessories, 230V	on req



7449A

The Fluke 7449A Computer-Aided Oscilloscope/Meter Calibration Cluster adds oscilloscope calibration capability to the already impressive line up of capabilities of the Fluke 7404B Calibration Cluster. With the 7449A you get calibration and verification capability of oscilloscope vertical gain, horizontal timing and gain, vertical pulse characteristics, probe accuracy and compensation, current probe accuracy, and calibrator output accuracy along with up to six functions for meter calibration and reliable measurement capability. In the 7449A, instrumentation joins flexible software to give you combined oscilloscope/meter calibration on which you can depend.

Ordering Information

Model

January 1989 prices

7449A Computer-Aided Oscilloscope/ Meter Calibration Cluster	$50,520

Options

17XX-008 IEEE-488/RS232C Interface for 1722A	850

See previous page for 7404B options

Available Separately

7410A-400 Tektronix CG5001 Oscilloscope Calibrator	21,956

Page 254 6070A

Page 246 6062A

Page 263 PM 5193

Page 277 PM 5134

Page 290 PM 5785

Page 297 PM 5715

From ultra high frequency L-Band application to low-frequency mechanical testing, Fluke and Philips offer signal sources to fit your budget and performance needs. Fluke and Philips sources include:

- RF Signal Generators (10 Hz to 2100 MHz)
- RC + Function Generators (0.1 to 50 MHz)
- Pulse Generators (0.1 Hz to 125 MHz)
- Television Pattern Generators

Fluke's 6060 Series of Synthesized Signal Generators provide excellent spectral purity and amplitude accuracy at frequencies up to 2100 MHz. Simple, solid construction provides excellent performance with high reliability and minimum downtime.

Philips PM 5110 low distortion RC generators provide low distortion audio signals at a price that is well within the budget of small service labs as well as educational institutions. At the other end of the performance spectrum is the PM 5193 Synthesized Function generator. This model combines a full featured 50 MHz function generator (including sweep and internal and external AM and FM), with a 3 ns rise-time pulse generator.

Philips pulse generators are used for pulse response measurements in design and service applications. The PM 5785 and PM 5786 feature a simple front panel layout, supplemented by "Time Setting Error" indicators.

Selection Guide 244
Synthesized RF Signal Generators 246
Function Generators 263
Pulse Generators 290
Video & Audio Generators 301
TV & Video Pattern Generators 307

Selection Guides

Synthesized RF Signal Generators

Models	Frequency			Amplitude			Modulation					Purity				SSB Noise			Res FM	Miscellaneous						
	Minimum	Maximum	Resolution	Minimum	Maximum	Resolution	Int. Source	AM/FM	ø Modulation	Combination	Pulse	Harmonics	Sub-Harmonics	Spurious	Line Spurious	For 1 Hz BW	At Frequency	With Offset	RMS 15kHz BW at 500 MHz	Switching Time	Rev. Pwr. Protect	Rel. Ampl. &	Digital Sweep	Audio Out	IEEE-488 I/F	Page
	kHz	MHz	Hz	dBm	dBm	dBm						dBc*	dBc*	dBc*	dBc*	dBc*	MHz	kHz	Hz	ms						
6011A	0.01	11	0.1/10	-55	+27	0.01		Opt				-40	–	-60	–	-106	11	20	–	2/34		•			Opt	260
6060B/AK[1]	10	1050	10	-127	+13	0.1	•	•		•		-30	–	-60	–	-116	500	20	12	100	•	•			Opt	252
6060A/AN[2]	10	520	10	-127	+13	0.1	•	•		•		-30	–	-35	–	-113	500	20	15	100	•	•			•	250
6060B	10	1050	10	-127	+13	0.1	•	•		•		-30	–	-60	–	-116	500	20	10	100	•	•			Opt	246
6061A	10	1050	10	-127	+13	0.1	•	•		•		-30	–	-60	–	-123	500	20	6	100	•	•			•	246
6062A	100	2100	10/20	-127	+13	0.1	•	•	•	•	•	-30	-45	-54	–	-123	500	20	6	100	•	•			•	246
6070A	200	520	1	-127	+19	0.1	•	•	•	•	Opt	-35	–	-90	-56	-132	500	20	2.5	85	Opt	•	•	•	•	254
6071A	200	1040	1/2	-127	+19	0.1	•	•	•	•		-25	-35	-84	-50	-132	500	20	2.5	85	Opt	•	•	•	•	254
6160B	1000	160	0.1/1	+3	+13	Vac						-30	–	-83	–	-121	160	32	–	0.8					Opt	258

*– Not applicable or insignificant •Yes *At maximum carrier frequency (1) For pager and communications testing (2) Includes FM deviation meter*

Function Generators

Models	Frequency Range	Setting Error	Output Vp-p	DC Offset	Waveforms						Variable Duty Cycle	Output Characteristics			Sweep				Burst	Single	Gating	Int	Ext	IEEE/IEC	Pg
															Linear		Log								
	Hz-MHz				∿	⊓⊔	⋀	1) ⊓	⟋	⋂		600Ω	50Ω	TTL	Int	Ext	Int	Ext				AM	FM		
PM 5109	10-0.1	±5%	30		•	•						•	•	•											288
PM 5110	10-0.1	4%	6		•	•						•		•											287
PM 5131	0.1-2	10%	30	•	•	•	•						•	•			•	•							285
PM 5132	0.1-2	2%	30	•	•	•	•	•			•	•	•	•	•	•									283
PM 5133***	0.01-2	3%	20	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•			•		280
PM 5134*	0.001-20	5%	20	•	•	•	•	•			•	•	•	•	•	•			•	•		•	•		277
PM 5190	0.001-2	1ppm	20	•	•	•	•						•	•								•		IEC	274
PM 5191	0.0001-2	1ppm	30	•	•	•	•		•				•	•								•		IEEE	271
PM 5192	0.0001-20	1ppm	20	•	•	•	•		•				•	•	•	•	•	•			•	•	•	IEEE	268
PM 5193**	0.0001-50	1ppm	20	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	IEEE	263

**PM 5134 also provides crystal mode and crystal AM mode **PM 5193 includes 3 ns pulse generator 1) positive and negative ***PM 5133S adds audio sweep output*

6060 Series Option Compatibility

Option	Description	6060A	6060A/AN	6060B	6060B/AK	6061A	6062A
6060A-130	Most Accurate Timebase	–	–	1	1	1	1
6060B-132	Second Best Timebase	–	–	1	1	1	1
6060B-488	IEEE-488 Interface	–	#	•	•	#	#
6060A-488K	IEEE-488 Interface Kit	•	–	–	–	–	–
6060B-488K	IEEE-488 Interface Kit	–	–	•	•	–	–
6060A-570K	Non-Volatile Memory	•	–	–	–	–	–
6060A-651	Low-Rate FM	–	–	•	*	–	•
6060B-651	Low-Rate FM	–	–	–	*	•	–
6060B-830	Rear Output	–	–	•	•	•	–
6062A-830	Rear Output	–	–	–	–	–	•
Other Items							
Y6001	Rack Kit w/24" Slides	•	•	•	•	•	•

Notes: All options are customer-installable except where noted.

• Compatible option

#Option included

** Feature included*

1 Factory installation only. Only one timebase installed in one instrument

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Selection Guides

Pulse Generators

Model	Transition Time	Duration	Max. Frequency	Operating Modes			External Control					Outputs					Pg
				Squarewave	Double Pulse	Counted Burst	External Trigger	Var. Trigger Level	Var. Delay	External Duration	External Gate	Amp. (50Ω load)	Offset (50Ω load)	Pulse Outputs	Sync (Clock)	TTL	
PM 5785	1,1.5, 2ns	3.5ns to 100ms	125 MHz	•	•	Opt	•	•	8ns to 100ms	•	•	0.2V to 5V	-2.5V to +2.5V	A,B	•		290
PM 5786	2ns to 0.1s	3.5ns to 100ms	125 MHz	•	•	Opt	•	•	8ns to 100ms	•	•	0.2V to 5V	-2.5V to +2.5V	A,B	•		290
PM 5712	4ns	10ns to 100ms	50 MHz	•	•		•		10ns to 100ms	•	•	0.2V to 10V	-5V to +2V	A	•	•	297
PM 5715	6ns to 0.5s	10ns to 100ms	50 MHz	•	•		•		10ns to 100ms	•	•	0.2V to 10V	-5V to +2.5V	A	•	•	297
PM 5716	6ns to 0.1s	10ns to 100ms	50 MHz	•	•		•	•	10ns to 100ms	•	•	2V to 20V	(1)	A	• (2 outputs)		294
PM 5705	<10ns	50ns to 500ms	10 MHz	•			•			•		+1V to +15V	0V to 2V	A		• (2 outputs)	299

Note 1: Amplitudes may be set within -20V to +20V window.

TV and Audio Generators

Models	Frequency			Amplitude			Modulation			Purity		SSB ø Noise			Res FM	Miscellaneous			Pg
	Minimum	Maximum	Resolution	Minimum	Maximum	Resolution	Int. Source	AM/ FM	Video	Harmonics	Spurious	For 1 Hz BW	At Frequency	With Offset	RMS, 15kHz BW at 500	Switching Time	Digital Sweep	IEEE-488 I/F	
	kHz	MHz	Hz	dBm	dBm	dBm				dBc*	dBc*	dBc	MHz	kHz	Hz	ms			
PM 5390	100	1020	1k/10k	-127	-7	(1)	•	•	•	-30	-30	-100	340	20	75	100	•	•	301
PM 5390S	100	1020	1k/10k	-127	+13	(1)	•	•	•	-20	-30	-100	340	20	75	100	•	•	301
PM 5326**	100	125	10.10k	–	(1)	–	•	•	•	–	–	–	–	–	–	–	•		305

*– Not applicable or insignificant • Yes *At maximum carrier frequency (1) Max output 50 mV at 75Ω. Continuous attenuation to -80 dB*
***PM 5326X adds counter facility*

TV and Video Pattern Generators

Model	Color and Monochrome TV	PAL	NTSC	SECAM	VCR/VLP	Video Monitors	Page
PM 5514V		•	•		•	•	315
PM 5515	•	•	•		•		307
PM 5518	•		•	•	•		307

Terms used in Signal Sources

dBc: The ratio (in dB) between two signals, where the reference signal is considered the "carrier". Useful for expressing relative levels for noise or spurious products on a signal generator's output signal, in terms of db below the carrier.

Incidental AM: Unwanted amplitude modulation that occurs when frequency modulating. Seldom a significant problem in modern signal generators.

Modulation Depth: Refers to amount of modulation, or "loudness" in audio terms. In FM and PM, modulation depth is determined by deviation; in AM it is determined by the percent of modulation.

Phase Noise: Short-term, random phase variations of an RF signal, a result of electrical noise in the signal generator's circuits. Expressed in dBc/Hz, which is noise density in a 1Hz equivalent bandwidth, relative to the carrier amplitude.

Residual FM: A measure of FM noise (short-term instabilities) of a signal generator's output, as measured with an FM modulatin meter. It is a key specification when a generator is used for testing FM radios.

Spectral Purity: A general term used to refer to the cleanliness of an RF signal...its freedom from contamination by noise and spurious signals.

Spurious: Unwanted discrete frequencies present on the output of a signal generator, measured relative to carrier level in dBc. Usually this term is taken to mean the "non-harmonic" spurious specification for a signal generator. Therefore, the spurious specification for the 6060B is -60 dBc. In the more general sense, spurious refers to all undesired, discrete (non-random) outputs from a signal generator, including additionally harmonics, sub-harmonics, and line-related products.

SSB Phase Noise: A plot of the phase noise spectrum of one side of an RF signal. (The two sides should be symmetrical.)

Synthesized RF Signal Generators

6060B, 6061A & 6062A

6060B

6061A

6062A

6060 Series: Synthesized RF Signal Generators
.01 to 1050 MHz and 0.1 to 2100 MHz
±1 dB amplitude accuracy to 1 GHz and ±1.5 dB accuracy to 2100 MHz (6062A)
Non-harmonic spurious -60 dBc to 1050 MHz
GPIB/IEEE-488
Built-in diagnostics and error code display
Reverse power protection
50 location non-volatile memory
Relative frequency and amplitude modes
Bright-digit editing

Economy and Performance

The Fluke 6060 Series is a family of fully programmable, synthesized signal generators covering 10 kHz to 2100 MHz.

The 6060B is an economical solution for most general purpose RF testing needs. The 6061A is equivalent to the 6060B, but has superior noise performance, making it desirable for receiver testing. These generators have output frequency selectable in 10 Hz steps from 10 kHz to 1050 MHz. Non-harmonic spurious products are less than -60 dBc, and harmonics less than -30 dBc. Level is programmable in 0.1 dB steps over the range -147 to +13 dBm, with overrange to +19 dBm. Accuracy is guaranteed ±1 dB in the range -127 dBm to +13 dBm.

The 6062A spans 100 kHz to 2100 MHz in 20 Hz steps (10 Hz steps below 1050 MHz). Specified amplitude accuracy is ±1.5 dB from -127 dBm to +13 dBm. Like its lower frequency family members, it has amplitude and frequency modulation. Also, the 6062A has phase modulation and fast-rise pulse modulation.

High-performance Pulse Modulation in the 6062A

The 6062A's gallium arsenide pulse modulator generates fast, high quality pulses for testing of pulsed communication and navigation circuits. It employs a design that can generate very narrow pulses, limited only by the modulator's 15 nanosecond rise and fall time.

Microprocessor Control

Microprocessor technology gives the 6060 family sophisticated operator functions including:

Keyboard Parameter Entry and Fluke **Bright-digit Editing.**

Increment Step Function, to allow an operator to vary frequency, amplitude, or modulation in specific increments.

Memory Store and Recall, for fifty complete front panel set-ups with internal non-volatile memory.

Relative Amplitude allows compensation for cable loss in test set-ups.

Relative Frequency speeds testing of frequencies relative to a reference, during filter testing or receiver selectivity measurements.

Self-Test Capabilities

Built-in diagnostics and error code displays provide immediate feedback of incorrect operation. Also, the generators perform a series of internal digital and analog tests at power-up and isolate problem areas immediately via a coded display on the front panel. These internal checks may be accessed and initiated at any time from the front panel. Special service and troubleshooting test routines are contained within the unit to aid in calibration and maintenance.

Options Summary

The GPIB/IEEE-488* interface is optional on the 6060B (Option 488), and is included as standard equipment on the 6061A and 6062A. The generators come with a 10 MHz free-air crystal reference oscillator, or may be fitted with one of two oven oscillator references: the high stability reference (Option -130) with ±5x10^{-10}/day aging rate, or a medium stability reference (Option -132) with ±1x10^{-7}/month aging. Other options are rear output (Option -850), and low-rate FM (Option -651).

6060B General Purpose 1 GHz Signal Generator

- 10 kHz to 1050 MHz, 10 Hz resolution
- -127 to +13 dBm output, plus overrange
- 1 dB amplitude accuracy
- 0.1 dB resolution
- Non-harmonic spurious -60 dBc
- IEEE-488 (optional)
- Reverse power protection
- Non-volatile memory
- Relative frequency and amplitude modes

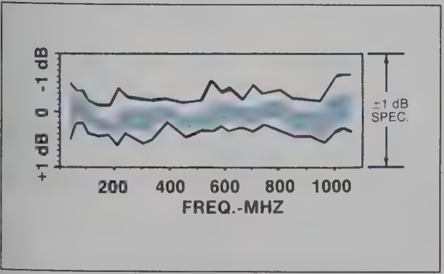
6061A Low-Noise Performance

- All features of the 6060B, plus:
- IEEE-488 included standard
- Lower SSB phase noise: typical -123 dBc/Hz at 20 kHz offset from 500 MHz carrier
- Lower Residual FM: 12 Hz rms at 1000 MHz

6062A 2.1 GHz General Purpose Signal Generator

- Contains all the features of the 6060B and 6061A
- Incorporates the low-noise improvements of the 6061A
- Adds these new features:
- Frequency coverage from 0.1 to 2100 MHz Phase modulation
- Fast-rise pulse modulation
- AC/DC-coupled AM
- 400 kHz FM deviation on 1050 to 2100 MHz range
- On-site manual or automated calibration
- IEEE-488 included standard

Typical Level Accuracy vs. Frequency for 6060B, measured at -127 dBm



Specifications

Technical Specifications

Frequency

Range: .01 to 1050 MHz (6060B and 6061A); .1 to 2100 MHz (6062A)

Resolution: 10 Hz to 1050 MHz, 20 Hz from 1050 to 2100 MHz (6062A only)

Switching Speed: <100 ms to be within 100 Hz of final frequency

Accuracy & Stability: Same as Reference Oscillator

Reference Oscillator

Internal Reference Oscillator Characteristics

Characteristic	Standard, Free-Air Crystal	-132 Option, Medium Stability Oven	-130Option, High Stability Oven
Frequency	10 MHz	10 MHz	10 MHz
Temperature	<±5x10^{-6} total, 0-50°C	<±1x10^{-7} total, 0-50°C	<±2x10^{-10} /°C 0-50°C
Aging Rate	<±5x10^{-7} /mo	<±1x10^{-7} /mo	<±5x10^{-10} day <±1.5x10^{-8} /mo
Warm-up (typical)	1 hr to within 1 ppm of final frequency	20 min to within <±3x10^{-8} of final frequency	30 min to within <±1x10^{-8} of final frequency

Reference Output

Frequency: 10 MHz, sinewave

Level: 0 dBm min into 50 Ωs

Source Impedance: 50 Ωs nominal

External Reference

Input Frequency: 1, 2, 2.5, 5, 10 MHz

Input Level: .3 to 4V pk-pk, sinewave or squarewave

Input Impedance: 50 Ωs nominal

Spectral Purity

Harmonics:

Amplitude	6060B and 6061A	6062A
+13 to +16 dBm	N/A	-25 dBc
>+13 dBm	-30 dBc (freq. >100 kHz)	-30 dBc (freq. >1 MHz)
	-26 dBc (10-100 kHz)	-25 dBc (0.1-1 MHz)

Subharmonics:

Carrier Frequency	6060B and 6061A	6062A
Below 1050 MHz	None	None
1050 to 2100 MHz	N/A	-45 dBc

Non-Harmonic Spurious:

Output Frequency	6060B and 6061A	6062A
10 kHz to 100 kHz	-55 dBc	N/A
.1 to 1050 MHz	-60 dBc	-60 dBc
1050 to 2100 MHz	N/A	-54 dBc

For offsets >10 kHz from carrier, cw mode

Residual FM (Hz rms) in 0.3 to 3 kHz BW:

Frequency Range	6060B	6061A		6062A	
	(Spec)	(Spec)	(typ.)	(Spec)	(typ.)
Below 245 MHz	20	12	8	12	8
245 to 512 MHz	10	6	4	6	4
512 to 1050 MHz	20	12	8	12	8
1050 to 2100 MHz	N/A	N/A	N/A	24	16

**Residual FM specifications for 6060B apply for temperature 25°C ±5°C. 6061A and 6062A specifications apply for full 0° to 50°C range.*

Residual FM (Hz rms) in .05 to 15 kHz BW:

Frequency Range	6060B	6061A		6062A	
	(Spec)	(Spec)	(typ.)	(Spec)	(typ.)
Below 245 MHz	44	18	12	18	12
245 to 512 MHz	22	9	6	9	6
512 to 1050 MHz	44	18	12	18	12
1050 to 2100 MHz	N/A	N/A	N/A	36	24

Residual FM (Hz rms) CCITT:

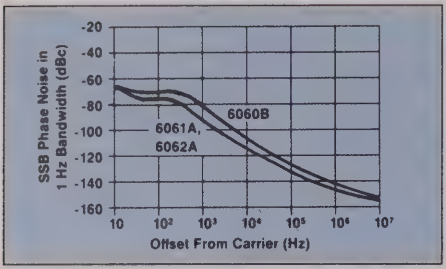
Frequency Range	6060B	6061A		6062A	
	Not Specified	(Spec)	(typ.)	(Spec)	(typ.)
Below 245 MHz		10	7	10	7
245 to 512 MHz		5	3.5	5	3.5
512 to 1050 MHz		10	7	10	7
1050 to 2100 MHz		N/A	N/A	20	14

Residual AM in .05 to 15 kHz BW: <0.1% rms (-60 dBc)

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

6060B, 6061A & 6062A

Typical SSB Phase Noise @ 500 MHz (with internal reference)



Amplitude Range: 6060B and 6061A: -127 to +13 dBm (+13 dBm peak on AM), with overrange to +19 dBm and underrange to -147 dBm. 6062A: -137 to +16 dBm (+16 dBm peak on AM) to 1050 MHz, to +13 dBm (+13 dBm peak on AM) above 1050 MHz. Overrange to +17 dBm and underrange to -147 dBm

Resolution: 0.1 dB

Annunciators: 6060B and 6061A: dB, dBm, V, mV, µV; 6062A: dB, dBm, V, mV, µV, dB µV, dB mv

Amplitude Accuracy: 25°C ±5°C

6060B and 6061A

Amplitude Range	10 kHz to 400 kHz	400 kHz to 1050 MHz
+13 to -100 dBm	±2 dB	±1 dB
-100 to -127 dBm	±3 dB	±1 dB

6062A

Amplitude Range	1 MHz to 1050 MHz	1050 kHz to 2100 MHz
+16 to -127 dBm	±1.0 dB	N/A
+13 to -127 dBm	±1.0 dBm	±1.5 dB

Amplitude Accuracy: 0°C to 50°C

6060B and 6061A

Amplitude Range	400 kHz to 1050 MHz
+13 to -127 dBm	±1.5 dB

6062A

Amplitude Range	100 kHz to 1 MHz	1 to 1050 MHz	1050 to 2100 MHz
+16 to +13 dBm	±2 dB	±1.5 dB	N/A
+13 to -127 dBm	±2 dB	±1.5 dB	±1.5 dB

Output Impedance: 150 Ωs, nominal

Output VSWR:
<1.5:1 for amplitude <+1 dBm
<2.0:1 for amplitude >+1 dBm

Reverse Power Protection: 6060B and 6061A: 50W RF from a 50Ω source, 10 kHz to 1050 MHz. Will withstand up to 50V dc. 6062A: 25W RF from a 50Ω source; up to 30V dc

Trip/Reset: Flashing RF OFF annunciator indicates when Reverse Power Protection circuit is tripped. Pushing RF ON/OFF button will reset generator. The 6062A is protected when the instrument is off; the 6060B and 6061A are not.

Leakage:

	6060B	6061A	6062A
RF Leakage at Carrier Frequency	1 µ V	0.5 µ V	1 µ V

Supplemental Characteristics

Amplitude Switching Speed: <100 ms typical (within 0.1 dB of selected value)

Level Flatness: ±0.5 dB (6060B and 6061A)

Amplitude Modulation

AM Depth: 0 to 99% in 1% steps

AM Accuracy: (6060B and 6061A)
±(2% + 4% of setting)

AM Accuracy: (6062A)
±(3% + 5% of setting), 0.1 to 1 MHz, to +16 dBm pk
±(2% + 4% of setting), 1 to 1050 MHz, to +16 dBm pk
±(2% + 4% of setting), 1050 to 2100 MHz, to +13 dBm pk

AM Distortion: 6060B and 6061A

AM Depth	10 kHz to 1050 MHz
0 to 30% AM	<1.5% THD
30 to 70% AM	<3% THD
70 to 90% AM	<5% THD

AM Distortion: 6062A

AM Depth	100 kHz to 1 MHz	1 MHz to 1050 MHz	1050 MHz to 2100 MHz
0 to 30% AM	<3% THD	<1.5% THD	<3% THD
30 to 70% AM	<5% THD	<3% THD	<3% THD
70 to 99% AM	<7% THD	<5% THD	<5% THD

Incidental FM:
<.3 f_m at internal rates and <30% AM to 1050 MHz
<.6 f_m above 1050 MHz (6062A)

Rates

Internal Rates: 1400 Hz and 1 kHz (see Modulation Source for specifications)

External BW: 1(3 dB)

	6060B & 6061A	6062A
AC-coupled	.02 to 30 kHz	.02 to 50 kHz
DC-coupled	N/A	DC to 50 kHz

Frequency Modulation

Deviation Ranges: 100 to 999 Hz, 1 to 9.99 kHz, 10 to 99.9 kHz, 100 to 400 kHz (6062A only)

Maximum Deviation: The following table applies for modulating frequencies of 200 Hz and above

	Maximum Peak Deviation	
Output Frequency	6060B and 6061A	6062A
Below 245 MHz	100 kHz	200 kHz
245 to 512 MHz	100 kHz	100 kHz
512 to 1050 MHz	100 kHz	200 kHz
1050 to 2100 MHz	N/A	400 kHz

Maximum Deviation for Low Modulating Frequencies: At low audio frequencies, maximum FM deviation is modulation-index limited. Use the following formulas to compute maximum allowable deviation

	6060B and 6061A	6062A
Below 24 MHz	dev. = $2f_m(f_o+800)$	dev. = $2f_m(f_o+800)$
245 to 1050 MHz	dev. = $2f_mf_o$	
245 to 2100 MHz		dev. = $2f_mf_o$

f_o= RF frequency in MHz
f_m= modulation frequency in Hz
dev.= max peak deviation in Hz

Example: If f_o = 300 MHz and f_m = 50 Hz, the maximum allowable deviation is 30 kHz. i.e., (2)(50)(300) = 30,000 Hz or 30 kHz

FM Deviation Accuracy: ±7% for rates of 0.3 to 20 kHz for carrier frequency greater than 400 kHz, FM deviation >100 Hz

AF Bandwidth: .02 to 100 kHz (3 dB)

Distortion: Less than 1% THD for .3 to 20 kHz rates, FM deviation >100 Hz (effects of Residual FM excluded)

Incidental AM: Less than 1% AM at 1 kHz rate and less than 50 kHz deviation

Internal Rates: 400 Hz and 1 kHz (see Modulation Source for specifications)

External BW: (3 dB) 20 Hz to 100 kHz

Phase Modulation (6062A only)

Deviation Ranges: .01-.099 rad, .100-.999 rad, 1.00-9.99 rad, and 10.0-40.0 rad

Maximum Phase Deviation:

	Peak Deviation
Below 245 MHz	20 radians
245 to 512 MHz	10 radians
512 to 1050 MHz	20 radians
1050 to 2100 MHz	40 radians

Accuracy: ±7% for rates of 0.3 to 10 kHz and greater than .01 rad deviation

Distortion: Less than 1% THD at 1 kHz rate and >.01 rad deviation

Bandwidth: 20 Hz to 10 kHz (3 dB)

Incidental AM: 1Less than 1% AM at 1 kHz rate and less than 40 rad deviation

Pulse Modulation (6062A only)

ON/OFF Ratio: 80 dB minimum
Rise and Fall Times: 15 nanoseconds maximum
Level Error: For pulse width ≥50 nsec, power in pulse within ±0.5 dB of CW level
Duty Cycle: 0-100%
Rep Rate: DC-16 MHz
Internal Modulation: 400 Hz, 1000 Hz rates, 50% duty cycle
Pulse Modulator Input (External): Nominal 50Ω impedance with internal pull-up. Can be driven directly by TTL

Input Voltage	Modulator State*
<0.9 Volts	RF OFF
>1.1 Volts	RF ON
Open Circuit	RF ON

**EXT PULSE enabled*

Modulation Source

Internal: 400 Hz or 1 kHz, ±3% for 20-30°C; add ±0.1%/°C outside this range
External: 1 volt peak causes indicated modulation index. Internal and External modulation sources may be enabled simultaneously, and combine linearly
Input Impedance: 600 Ωs nominal (560 Ωs nominal when EXT AM and EXT FM enabled simultaneously)
External Modulation Annunciators: EXT HI/EXT LO indicator when 1V peak, ±2% is applied at MOD IN connector .02 to 100 kHz BW

Memory

Type: Non-volatile. Data is stored 2 years (typical) with power off
Size: 50 complete front panel settings
Features: 1Store, recall, sequence

Option Specifications

Option -130: High Stability Crystal Oscillator
Option -132: Medium Stability Crystal Oscillator
See data under Reference Oscillator section.
Option -488: IEEE-488 Compatible Interface (standard on 6061A and 6062A). For field installation order -489K (Kit)
Interface: IEEE-488-1978
Functions Controlled: All front panel controls except line power switch
Data Output: Instrument status, stored memory contents, instrument settled, instrument ID, option complement, uncal/reject entry status, operating time
Indicators: Remote, Addressed, SRQ
Interface Functions: SH1, AH1, T5, TE0, L3, LE0, SR1, LR1, PP0, DC1, DT1, C0, E1
Option -651: Low Rate AC-coupled FM
Maximum Deviation: 9.99 kHz
Bandwidth (3 dB): 0.5 Hz to 100 kHz (typical)
Droop: 15% typical on 7 Hz squarewave
Maximum DC Input: ±10 mV
Note: See also 6060B/AK for enhanced low-rate FM capability.
Option -830: Rear Only RF output and modulation inputs. Type N RF output connector on rear panel

General Specifications

Operating Temperature: 0°C to 50°C
Storage Temperature: -40°C to 75°C
Humidity (operating): 0-95% up to 30°C, 0-75% 30°C to 40°C, 0-45% 40°C to 50°C
Altitude (operating): ≤10,000 ft
Power: 100, 120, 220, 240V ac ±10%, 47-63 Hz, (for 400 Hz consult the factory) <180 VA, (<15VA standby with opt -130
Weight: <16 kg (35 lb)
Size: 13.3 cm H x 43.2 cm W x 55.3 cm D (5.25 in x 17 in x 21.8 in)
EMI: Meets MIL-STD 461B RE02, CE03, FCC Part 15(j), Class B

Rear Panel Connectors and Controls

Standard:
10 MHz OUT: Connector to monitor internal 10 MHz reference
REF INT/EXT: Control to enable REF IN connector and disable internal reference
REF IN: Connector to input external reference (see Reference Oscillator)
Option:
MOD IN, RF OUT: Present only if -830 is installed
PULSE IN (6062A): Present only if -830 is installed
IEEE-488 Connector: Standard on 6061A and 6062A, optional on 6060B

Ordering Information

Models

January 1989 prices

6060B 1 GHz Signal Generator	$5225
6061A 1 GHz Signal Generator	5895
6062A 2 GHz Signal Generator	11,295

Options (for above Models)*

-130 High Stability Reference	1250
-132 Mid Stability Reference	400
-488 IEEE-488 Interface (6060B only)	395
-488K IEEE-488 Interface (6060B only)	415
-651 Low-rate AC-FM	395
-830 Rear Output and Modulation Input	125

**See chart page 244 for compatibility*

Accessories (Also see page 485)

Y6001 Rack Mount Kit, inc 24" slides	$295
Y9100 Attenuator, 50Ω, 6 dB, BNC	55
Y9101 Attenuator, 50Ω, 14 dB, BNC	55
Y9102 Attenuator, 50Ω, 20 dB, BNC	55
Y9103 50Ω Feed-through Termination, BNC	35
Y9111 3 ft (0.91m) 50Ω Cable, BNC to BNC	20
Y9112 6 ft (1.83m) 50Ω Cable, BNC to BNC	20
Y9301 Min-Loss Pad, 50Ω to 75Ω	75
Y9307 Adapter, N to BNC, 75Ω	25
Y9308 Adapter, N to BNC, 50Ω	20
Y9315 Coaxial Cable, N male to N male, 6 ft	75
Y9316 Cap, Non-shorting, BNC	10
Y9317 50Ω Termination, N	95
PM 21XX Modular GPIB Switching System	see page 380
PM 2122 50Ω coaxial switch	see page 382
PM 2240 TestTeam Software	see page 374

Service & Support

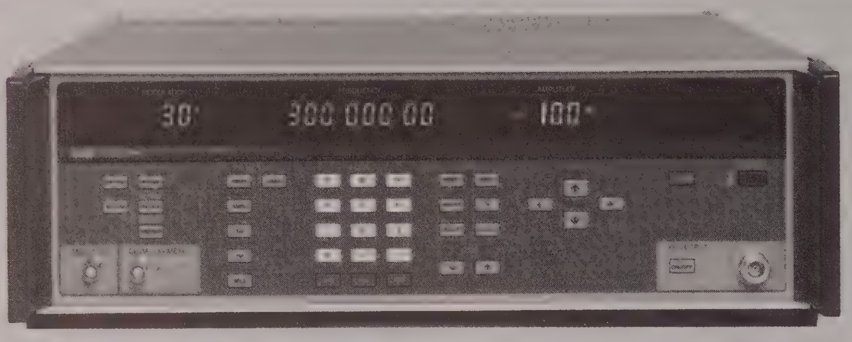
Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-6060B Repair (w/calibration)	422
SC1-6060B Repair (cal w/in or out data)	497
SC1-6060B Repair. (cal w/in and out data)	572
SC2-6060B Cal (1 yr recommended)	369
SC2-6060B Cal (1 yr w/in or out data)	444
SC2-6060B Cal (1 yr w/in and out data)	519
SC1-6061A Repair (w/calibration)	430
SC1-6061A Repair (cal w/in or out data)	505
SC1-6061A Repair (cal w/in and out data)	580
SC2-6061A Cal (1 yr recommended)	396
SC2-6061A Cal (1 yr w/in or out data)	471
SC2-6061A Cal (1 yr w/in and out data)	546
SC1-6062A Repair (w/calibration)	443
SC1-6062A Repair (cal w/in or out data)	518
SC1-6062A Repair (cal w/in and out data)	593
SC2-6062A Cal (1 yr recommended)	432
SC2-6062A Cal (1 yr w/in or out data)	507
SC2-6062A Cal (1 yr w/in and out data)	582

6060A/AN



(NSN 6625-01-222-5007) **6060A/AN**

6060A/AN Signal Generator/Deviation Meter

- 10 kHz to 520 MHz
- -127 dBm to +13 dBm
- 500 kHz FM deviation
- Built-in FM deviation meter for transmitter alignment

The 6060A/AN combines the capabilities of the Fluke 6060B, with the ability to measure FM deviation in one stand-alone unit.

The signal generator portion of this advanced unit has frequency range from 10 kHz to 520 MHz, +13 dBm to -127 dBm output amplitude range and AM and FM modulation.

The maximum FM deviation is 500 kHz allowing the 6060A/AN to be used on many more applications than just voice communications.

The user-interactive front panel provides instant operator feedback and helps reduce entry errors. A convenient memory feature will save you time. Also included standard are GPIB/IEEE-488* programmability and Reverse Power Protection. Surrounding all these capabilities is excellent RF shielding. And it is easy to service.

The FM Deviation measurement capability included in the 6060A/AN furnishes an effective means to measure the peak deviation (plus or minus) of a frequency modulated RF signal. Simply connect the signal of interest at the front panel connector provided for this function, then select the function and range. The result is displayed at the front panel.

Specifications

Technical Specifications

Specifications apply 1 hour after turn-on within operating temperature range.

Frequency (8-1/2-Digit Display)

Range: 0.01 MHz to 520 MHz
Resolution: 10 Hz
Accuracy: Same as reference (see Reference)
Reference
Internal: Accuracy within 10 ppm of indicated frequency. Unit operates on an internal free-air 10 MHz crystal oscillator, aging <±0.5 ppm/month. <±5 ppm for 25°C, ±25°C. Frequency stability <±0.5 ppm/hour 1 hour after warm up. Internal reference signal (10 MHz TTL) available at rear connector
External: Accepts 10 MHz TTL signal

Amplitude (3-1/2-Digit Display)

Range (Indicated): +13 (+13 peak on AM) to -127 dBm
Resolution: 0.1 dB (<1% or 1 nV in volts)
Accuracy: ±2.5 dB
Source SWR: <1.3, below -10 dBm
Spectral Purity (CW Mode Only)
Spurious: <-35 dBc
Harmonics: <-30 dBc from 10 MHz to 520 MHz; <-26 dBc from 0.01 MHz to 10 MHz
Residual FM (peak in 0.05 kHz to 15 kHz band): <200 Hz
Residual AM (in 0.05 kHz to 15 kHz band): <-60 dBc

Amplitude Modulation (2-Digit Display)

Depth Range: 0% to 99%
Resolution: 1%
Accuracy: ±6% of setting for internal rates; RF peak amplitude of +13 dBm or less
Distortion: <5% THD at 50% AM for 1 kHz rate
Rates: 10 Hz to 20 kHz
External Input Level: Less than 10V peak-to-peak into 600 Ωs

Frequency Modulation (3-Digit Display)

Deviation Ranges: 1 kHz to 9.99 kHz, 10 kHz to 99.9 kHz, and 100 kHz to 500 kHz
Maximum Deviation: 500 kHz at rates above 50 Hz. 50 kHz between frequencies of 0.1 MHz and 5 MHz and rates above 50 Hz
Resolution: Three digits
Accuracy: ±5% for 1 kHz rate and >1 kHz deviation
Rates: 0.05 kHz to 100 kHz
External Input Level: Less than 10V peak-to-peak into 600 Ωs
Modulation Source
Internal: 0.4 kHz or 1 kHz, ±5%
External: ±5% max; 1V peak provides indicated modulation index. Nominal input impedance is 600 Ωs
Modes: Any combination of Internal AM, Internal FM, External AM, and External FM. Modulation may also be disabled. The nominal input impedance with both External AM and External FM enabled is 560 Ωs
Deviation Meter
Frequency Input: 30 MHz to 500 MHz
Input Signal Level: 15 mV to 5V rms
Input Impedance: 50 Ωs nominal
Measurement Ranges: Two ranges of 500 kHz and 50.0 kHz full scale
Polarity: Selectable ± peak
Modulation Rate: 100 Hz to 8 kHz
Accuracy: ±6% of full scale range from 100 Hz to 8 kHz

General Specifications

Temperature: 0°C to 50°C (32°F to 122°F), operating; -40°C to 70°C (-40°F to 158°F), non-operating
Humidity Range: 0-95% non-condensing, operating
Vibration: 5 Hz to 15 Hz at 0.06 in, 15 Hz to 25 Hz at 0.04 in, and 25 Hz to 55 Hz at 0.02 in. DA, non-operating
Shock: Bench handling per MIL-T-28800C Class 5, Style E, non-operating
Electromagnetic Compatibility: The radiated emissions induce <1 µV of the generator's output signal into a 1-inch diameter, two-turn loop, 1 inch from any surface as measured into a 50Ω receiver. Also complies with the following standards:
CE03 of MIL-STD-461B (power and interconnecting leads), 0.015 MHz to 50 MHz
RE02 of MIL-STD-461B (14 kHz to 10 GHz)
FCC Part 15 (j), Class A
CISPR 11

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

Reverse Power Protection Level: Up to 50 watts from a 50Ω source, 0.01 MHz to 520 MHz. Will withstand up to 25V dc. Protection not provided when instrument is off
IEEE-488 Interface Functions (IEEE Std 488-1978): SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP0, DC1, DT1, C0, and E1
Size: 43 cm W x 13.3 cm H x 55.3 cm D (17 in x 5.25 x 21.8)
Power: 115V, 230V ac ±10%, 47 Hz to 400 Hz, <100 watts
Weight: <18.2 kg (40 lb)
Calibration Interval: After calibration, the equipment shall meet each performance requirement within the tolerance specified for a period of 9 months

Supplemental Characteristics

The following characteristics are provided to assist in the application of the instrument and to describe the typical performance that can be expected.

Frequency Switching Speed: <150 ms to be within 100 Hz of final frequency
Amplitude Switching Speed: <100 ms to be within 0.1 dB of final amplitude
Amplitude Range: Programmable to +19 dBm and -147.4 dBm, usable to +15 dBm. Fixed-Range, selected by Special Function, allows for more than 12 dB of vernier without switching the attenuator
AM Accuracy: ±(2% + 4% of setting) for internal rates, for depths 90% or less and peak amplitude of +13 dBm or less
AM Distortion: <1.5% THD to 30% AM, <30% to 70% AM, <5% to 90% AM at internal rates
Incidental FM: <0.3f_m for internal rates and 30% AM
FM Accuracy: ±7% for rates from 0.3 to 20 kHz >1 kHz deviation f_o >0.4 MHz
FM Distortion: <1% THD for rates of 0.3 kHz to 20 kHz, 1 kHz to 99.9 kHz deviation for f_o >5 MHz
Incidental AM: <1% AM at 1 kHz rate, for the maximum deviation or 50 kHz, whichever is less
Residual FM (rms in 0.3 kHz to 3 kHz Band): <15 Hz from 245 to 520 MHz; <30 Hz elsewhere
Residual FM (rms in 0.05 kHz to 15 kHz Band): <30 Hz from 245 to 520 MHz; <60 Hz elsewhere
Noise (at 20 kHz offset): <-113 dBc/Hz (except <-107 dBc/Hz below 245 MHz)
Spurious: <-60 dBc for offsets greater than 10 kHz. Fixed frequency spurs are <-60 dBc or <-140 dBm, whichever is larger
External Modulation: Annunciators indicate when a 1V peak signal is applied, ±2%, over a 0.02 kHz to 100 kHz band
Deviation Meter Accuracy: ±5% of reading ±1 count for rates between 100 Hz and 10 kHz
IEEE-488 Interface: All controls except the power switch and the internal/external reference switch are remotely programmable via IEEE Std 488-1978

Ordering Information

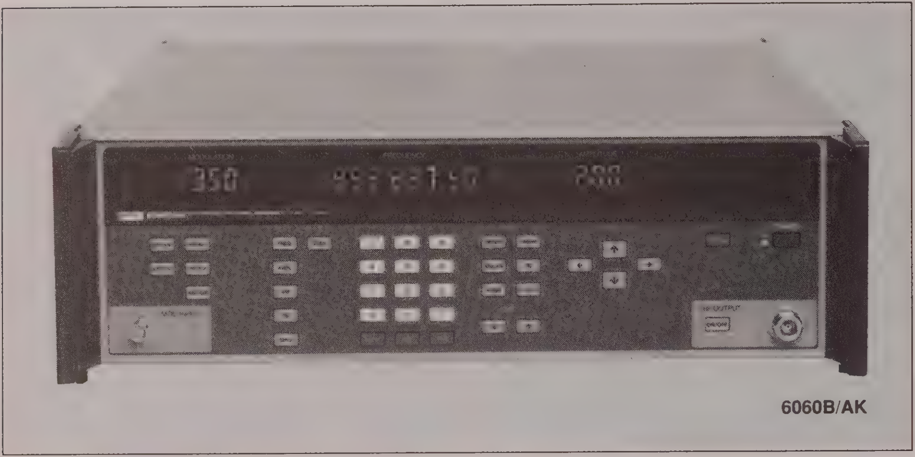
Model	January 1989 prices
6060A/AN Synthesized Signal Generator	$7500

Accessories (Also see page 485)

Y6001 Rack Mount Kit, includes 24" slides	295
Y9100 Attenuator, 50Ω, 6 dB, BNC	55
Y9101 Attenuator, 50Ω, 14 dB, BNC	55
Y9102 Attenuator, 50Ω, 20 dB, BNC	55
Y9103 50Ω Feed-through Termination, BNC	35
Y9111 3 ft (0.91m) 50Ω Cable, BNC	20
Y9112 6 ft (1.83m) 50Ω Cable, BNC	20
Y9301 Min-Loss Pad, 50Ω to 75Ω	75
Y9307 Adapter, N to BNC, 75Ω	25
Y9308 Adapter, N to BNC, 50Ω	20
Y9315 Coaxial Cable, N Male to N Male, 6 ft	75
Y9316 Cap, Non-shorting, BNC	10
Y9317 50Ω Termination, N	95
PM 21XX Modular GPIB Switching System	see page 380
PM 2122 50 Ω coaxial switch	see page 382
PM 2240 TestTeam software	see page 374

6060B/AK

GPIB
IEEE-488*



6060B/AK

6060B/AK: Pager & Communications Testing Signal Generator

- 10 kHz to 1050 MHz
- ±1 dB Absolute Level Accuracy from +13 dBm to -127 dBm
- Residual FM <8 Hz at 500 MHz
- RFI leakage <0.5 microvolts
- Compatible with digital paging codes
- 50 location non-volatile memory

The 6060B/AK is a special-purpose version of the 6060B, that has improved noise characteristics and enhanced Frequency Modulation capabilities. It is designed for radio communications testing; in particular, applications in which digital signaling using FSK is used in addition to voice.

This enhanced modulation characteristic of the 6060B/AK enables it to work well with digital squelch and digital paging systems. It will accommodate very low rate paging codes including Motorola, Golay-Sequential Code (GSC) NEC, NTT and British-Post-Office-Code-Standardization-Advisory-Group (POCSAG).

Specifications

Technical Specifications

Frequency

Frequency Range: 10 kHz to 1050 MHz. Output frequency is displayed on an 8-digit display
Frequency Resolution: 10 Hz
Switching Speed: <100 ms typical (within ±100 Hz of selected value)
Frequency Accuracy: Referenced to internal free-air 10 MHz crystal oscillator, <±0.5 ppm/month; <±5 ppm for 25°C ±25°C (see also Options -130 and -132). Internal 10 MHz reference sinewave output signal available at rear panel

Reference Output

Frequency: 10 MHz, sinewave
Level: 0 dBm min into 50 ohms
Source Impedance: 50 ohms nominal

External Reference

Input Frequency: 1, 2, 2.5, 5, 10 MHz
Input Level: .3 to 4V pk-pk, sinewave or squarewave
Input Impedance: 50 ohms nominal

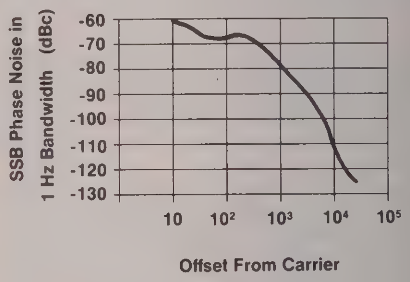
Amplitude

Amplitude Range: -127 to +13 dBm (+13 dBm peak on AM), with overrange to -147 and +19 dBm, displayed on a 3-digit display. Fixed-range output, selected by special function, allows more than 12 dB of vernier without attenuator switching
Amplitude Resolution: 0.1 dB. Annunciators for dB, dBm, V, mV, and µV provided on the display
Switching Speed: <100 msec typical (within 0.1 dB of selected value)
Amplitude Accuracy: ±1.0 dB 0.4-1050 MHz (20°C ±5°C)
Output Impedance: 50 ohms, nominal
Output SWR: <2.0; <1.5 below 1 dBm 2400 kHz
RF Leakage: <0.5 µV at carrier frequency

Spectral Purity

Spurious: <-60 dBc for offsets greater than 10 kHz, (-55 dBc <100 kHz)
Harmonics: <-30 dBc (-26 dBc <100 kHz)
Residual FM (0.3 to 3 kHz band): <8 Hz rms from 245 to 512 MHz; <16 Hz rms elsewhere
Residual FM (0.05 to 15 kHz band): <12 Hz rms from 245 to 512 MHz; <24 Hz rms elsewhere
Residual AM: 0.1% rms (-60 dBc) in 0.05 to 15 kHz band (-55 dBc <100 kHz)

Typical SSB Phase Noise @ 500 MHz (with internal reference)



Amplitude Modulation

Depth Range: 0 to 99%, with 1% resolution (displayed on 2-digit front panel display)
Accuracy: ±(2% + 4% of setting), for 0.1 to 3 kHz rates, depths to 90%, and peak amplitude of <+13 dBm
Distortion: <1.5% THD, to 30% AM; <3% THD, to 70% AM; <5% THD, to 90% AM for <950 MHz and levels <+8.0 dBm
Bandwidth: 20 Hz to 30 kHz, 3 dB
Incidental FM: <0.3 f_m for internal rates and <30% AM

Frequency Modulation

Deviation Ranges: 100 to 999 Hz; 1 to 9.99 kHz; and 10 to 99.9 kHz (displayed on 2-digit front panel display)
Maximum Deviation: Lesser of 99.9 kHz and $2f_m f_0$ above 245 MHz, or $2f_m(f_0 + 800)$ below 245 MHz, where f_0 is in MHz and f_m in kHz $(f_0-100)/3$ kHz below 0.4 MHz [f_0 in kHz]
Accuracy: ±7% for rates of 0.3 to 20 kHz (0.3 to 1 kHz for f_0 <0.4 MHz)
Distortion: <1% THD for rates of 0.3 to 20 kHz (0.3 to 1 kHz for f_0 <0.4 MHz) and <100 Hz deviation
Bandwidth: (3 dB) 0.5 Hz-100 kHz for <400 kHz carrier frequency
Droop: 15% on a 10 Hz squarewave
Incidental AM: <1% AM at 1 kHz rate and deviation of 50 kHz

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Modulation Source

Internal: 400 Hz and 1 kHz, ±3% for 20°C to 30°C (add ±0.1%/°C outside this range). Selectable from the front panel
External: 1 volt peak input (MOD IN BNC) provides indicated modulation index. Input impedance = 600 ohms, nominal
Modes: INTAM; INTFM; EXTAM; EXTFM; IN TAM and FM: EXTAM and FM; and INT(AM and/or FM) and EXT(AM and/or FM), in all nine combinations. Input impedance = 560 ohms, nominal, when EXTAM and FM are both enabled

Sub-Harmonic External Reference
Input: 1, 2, 2.5, 5, and 10 MHz, 0.3 to 4V p-p sine or squarewave into 50 ohms (nominal)
Input Connector: BNC on rear panel

Non-Volatile Memory

Description: Up to 50 front panel control settings can be retained for 2 years. Battery power is used when the 6060B/AK is in standby or the power cord is not attached.

Reverse Power Protection

Protection Level: Up to 50 watts from a 50 ohm source or 50V dc, from 10 kHz to 1050 MHz (dc blocking capacitor at output)
Trip/Reset: Flashing RFOFF annunciator indicates a tripped condition. Pushing RFON/OFF button on front panel will reset the output. Protection is not provided when the instrument is in off.

Option Specifications

All options are factory installable only.

High Stability Reference Option (-130)
Aging Rate: <±5 x 10^{-10}/day, after 21 days
Temperature Stability: <±2 x 10^{-10}/°C. Oven remains powered during standby
Installation: Mounts inside rear panel; includes auxiliary power supply

Mid Stability Reference Option (-132)
Aging Rate: ±5 x 10^{-7}/mo, after 21 days
Temperature Stability: ±1 x 10^{-7} (0° to 50°C)

IEEE-488 Compatible Interface Option (-488)
Functions: All front panel controls except the power switch are programmable via the IEEE-488 interface. Instrument status is also available remotely. The 6060B/AK supports the following IEEE-488 functions SH1, AH1, T5, L3, SR1, RL1, PP0, DC1, DT1, C0, E2

Rear RF Output and MOD Input Option (-830)
Description: Moves front panel RF OUTPUT and MOD INPUT connectors to the rear panel

General Specifications

Temperature: 0 to 50°C, operating; -40 to 75°C, non-operating
Humidity: 1 to 95% RH to 30°C; 0 to 75% RH to 50°C, operating
Altitude: 3,050m (10,000 feet), operating
Shock and Vibration: Per MIL-T-28800C, except spectral purity may be degraded; 5 to 15 Hz at 0.06 in; 15 to 25 Hz at 0.04 in; and 25 to 55 Hz at 0.02 in
EMI: Radiated emissions induce <0.5 µV at output frequency into a 1 inch diameter, 2 turn loop, 1 inch from any surface as measured into a 50 ohm receiver. Also compliance with the following standards:
CE03, MIL STD 461B Power and interconnecting leads, 0.015 to 50 MHz;
RE02, MIL STD 461B 14 kHz to 10 GHz, method RE02-1 and RE02-2 of MIL STD 462; FCC Part 15 (j), Class A;
Power: 100V, 120V, 200V, 240V ac ±10%, 47 to 63 Hz, <180 VA; <15 VA standby with Option -130
Size: 55.3 cm L x 43 cm W x 13.3 cm H (21.8 in L x 17 in W x 5 in H)
Weight: <15.9 kg (35 lb)

Ordering Information

Model

	January 1989 prices
6060B/AK Signal Generator	$5750

Options** (for 6060B/AK)

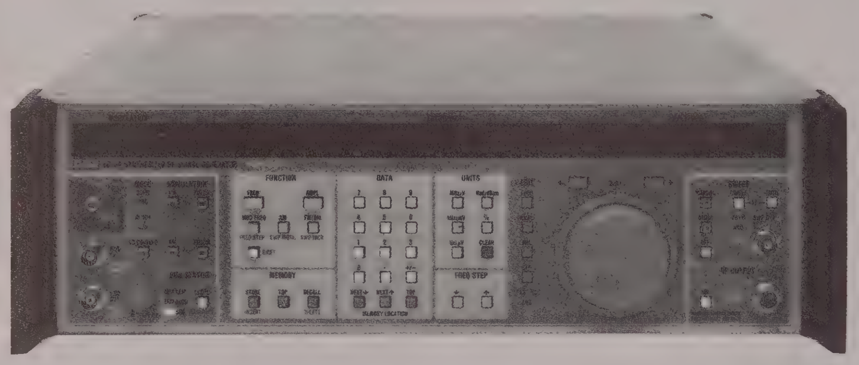
-130* High Stability Reference	1250
-132* Mid Stability Reference	400
-488 IEEE Interface	395
-488K IEEE-488 Interface	415
-830 Rear Output and Modulation Input	125

**See specifications on page 249*
***See option compatibility chart on page 244*

Accessories (Also see page 485)

Y6001 Rack Mount Kit, inc. 24" slides	295
Y9100 Attenuator, 50Ω, 6 dB, BNC	55
Y9101 Attenuator, 50Ω, 14 dB, BNC	55
Y9102 Attenuator, 50Ω, 20 dB, BNC	55
Y9103 50Ω Feedthru Termination, BNC	35
Y9111 3 ft (0.91m) 50Ω Cable, BNC	20
Y9112 6 ft (1.83m) 50Ω Cable, BNC	20
Y9301 Min-Loss Pad, 50Ω to 75Ω	75
Y9307 Adapter, N to BNC, 75Ω	25
Y9308 Adapter, N to BNC, 50Ω	20
Y9315 Coaxial Cable, N male to N male, 6 ft	75
Y9316 Cap, Non-shorting, BNC	10
Y9317 50Ω Termination, N	95

6070A & 6071A



6070A

6070A & 6071A, to 520 MHz or 1040 MHz

- Non-harmonic spurious outputs: -90 dBc to -100 dBc to 520 MHz
- Precision digital sweep
- Front panel memory
- AM, FM, øM modulation
- Responsive spin knob tuning
- Low output VSWR and optional reverse-power protection
- Relative amplitude and frequency mode

Design innovations in the 6070A and 6071A combine the precision resolution and settability of a synthesizer with the low-noise performance of the best open-loop signal generators on the market. And these two state-of-the-art instruments were developed to be competitively priced as well as cost effective in other ways.

The 6070A and 6071A are programmable and directly compatible with GPIB/IEEE-488*-1978. With them, you may make sophisticated tests and measurements rapidly and with great precision. On VHF and UHF receivers you can measure selectivity, sensitivity, intermodulation distortion, AM rejection, AGC response, audio hum, noise and distortion, and SINAD ratio. Or you can align a discriminator or check IF response using the digital sweep feature.

Spectral purity is excellent. Spurious outputs, those not related harmonically to either the carrier frequency or the power line frequency, are on the order of -90 dBc to -100 dBc to 520 MHz and -84 dBc above 520 MHz. The typical broadband noise floor is a comfortable -150 dBc per Hz, and the single sideband phase- noise is typically -138 dBc per Hz at 20 kHz offset from a 500 MHz carrier. These specifications, by any standard, reflect a truly excellent level of spectral purity.

AM, FM, øM Modulation

Amplitude modulation depth can be set from 0% to 99.9% in 0.1% steps. External dc coupling is provided for leveling, extending bandwidths down to dc, or providing analog control of out put amplitude.

Frequency or phase modulation can be set with deviations up to 1 MHz or 100 radians respectively, depending on the rf frequency. Exceptionally wide deviation is made possible by a high deviation mode that is automatically activated when required. External, dc-coupled FM is available for phase locking the instrument to another source. That extends the maximum deviation at low rates, and provides for analog sweeping with an external signal.

Simultaneous AM+FM or AM+øM is available internally or from internal-external combinations. The internal modulation oscillator covers a wide range of frequencies. It can be continually varied from 20 Hz to 200 kHz, with an overrange capability extending it from 1 Hz to 255 kHz in steps of approximately 0.1%.

The modulation oscillator output is available at a front panel connector. This provides you with an audio source separate from the rf out put. Typical total harmonic distortion is 0.05%.

IEEE-488 Interface

No option is required to make the 6070A or 6071A compatible with IEEE Std 488-1978; the capability is built in. And all of the functions that may be controlled from the front panel manually are also controllable remotely in an IEEE-488 system, except for turning power on and off and controlling the modulation signal output level. Status indicators are: Remote, Addressed, and SRQ. Interface functions are: SH1, AH1, T6, L3, SR1, RL1, DC1, DT1, C0, E2.

Precision Digital Sweep

Versatile sweep modes let you characterize devices such as wideband amplifiers, narrowband crystal filters, and other rf components. Repetitive, single, or manual modes are available with either symmetrical or asymetrical sweeps. Five sweep step intervals between 20 ms and 500 ms may be selected. A coincidental 0 to 10V staircase sweep signal is available at an output connector to drive X-Y recorders or oscilloscopes. Another rear-panel output signal provides Z-axis blanking for oscilloscopes or a pen-lift signal for X-Y recorders.

Front Panel Program Memory

Up to nine different combinations of front-panel control settings may be stored and later recalled. Up to 50 combinations may be stored in a non-volatile memory using Option -570. This feature reduces errors and saves time in making common measurements.

Responsive Spin-Knob Tuning

In addition to the simple keystroke operation and layout of the front-panel controls, a high-inertia, magnetically detented, optically coupled knob provides analog convenience when continuous adjustments are required. It may be used to select frequency, amplitude, or modulation. Each complete turn gives you 25 increments or decrements, depending on direction of rotation.

Low Output VSWR & Optional Reverse-Power Protection

The rf output impedance of the 6070A and 6071A is 50 ohms with a low source VSWR to minimize the effects of signals reflected from loads having a high VSWR. Option -870 protects the output circuits from being damaged when connected to a transceiver that accidentally transmits power.

Relative Units

A relative-amplitude mode makes it easy to compensate for cable loss, attenuation in the rf output, make linearity tests on detectors and amplifiers, and measure AGC characteristics. Output levels are selectable in 0.1 dB steps, all the way from -140 dBm to +19 dBm for frequencies up to 520 MHz (+13 dBm above 520 MHz). Flatness is typically ±0.2 dB from 200 kHz to 520 MHz, ±0.3 dB to 1040 MHz.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Besides offering 1 Hz resolution up to 520 MHz (2 Hz above 520 MHz), a relative-frequency mode allows you to display specific frequencies above and below a selected center frequency. It makes testing the frequency response of filters and IF strips easy.

Specifications

Technical Specifications

Specifications for frequencies above 520 MHz apply to 6071A only.

Frequency

6070A Ranges: 0.2 to 519.999 999 MHz
6071A Ranges: 0.2 to 1039.999 998 MHz
6070A Resolution: 1 Hz
6071A Resolution: 1 Hz (<520 MHz), 2 Hz (≥520 MHz)
Accuracy & Stability: Same as Reference Oscillator

Reference Oscillator

Internal Standard: 10 MHz quartz oscillator. Aging rate 1±0.5 ppm/month. Temperature effects: <±5 ppm 0 to 50°C instrument ambient (relative to 25°C)
Option -130: 10 MHz ovenized oscillator. (See options)
External: 1, 2, 2.5, 5, 10 MHz input. Level required is 0.3 to 4.0V pp sinewave or square wave. Input impedance is 50 ohms. External reference is automatically switched in when connected
Reference Output: 10 MHz TTL level

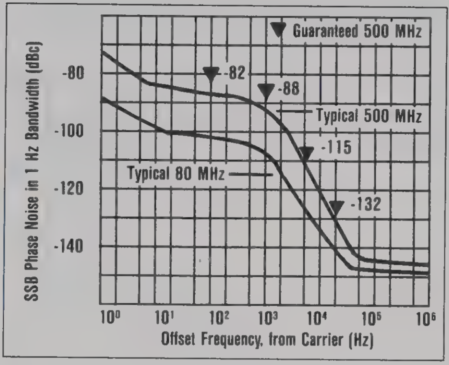
Spectral Purity

All specifications are with High Deviation mode off

SSB Phase Noise

SSB Phase Noise for CW and AM Modes (dBc/Hz)

Carrier Frequency Range	Offset Frequency, from Carrier				
	100 Hz	1 kHz	5 kHz	20 kHz	<3 MHz
0.2 to 62.5 MHz	-75	-85	-106	-123	-129
62.5 to 125 MHz	-94	-100	-125	-140	-144
125 to 250 MHz	-88	-94	-121	-138	-144
250 to 520 MHz	-82	-88	-115	-132	-144
520 to 1040 MHz	-76	-82	-109	-126	-138



Residual FM for CW and FM Modes (Hz rms)

Carrier Range	0.3 to 3 kHz bw	0.5* to 15 kHz bw
0.2 to 62.5 MHz	3.5	5.0
62.5 to 125 MHz	0.3	0.75
125 to 250 MHz	0.85	1.3
250 to 520 MHz	1.7	2.5
520 to 1040 MHz	3.4	5.0

**Typically the same for 0.02 to 15 kHz bandwidth.*

Residual AM: ≤0.02% rms (-74 dBc) in a 0.05 to 15 kHz post-detection bandwidth, referred to 100% sinewave modulation. Typically the same in a 0.02 to 15 kHz post-detection bandwidth

Spurious Signals (dBc)

Relationship to Output Carrier Frequency (f_0)	Carrier Frequency Range				
	200 kHz to 62.5 MHz	62.5 MHz to 125 MHz	125 MHz to 250 MHz	250 MHz to 520 MHz	520 MHz to 1040 MHz
Non-Harmonic <10 kHz offset 550 Hz to 10 kHz offset	-90 -70	-100 -82	-96 -76	-90 -70	-84 -64
Power Line, Display, Mechanical <550 Hz offset	-56	-68	-62	-56	-50
Sub-Harmonic $f_0/2$, $3f_0/2$, $5f_0/2$ offset	N/A	N/A	N/A	N/A	-35
Harmonic (6070A) f_0, $2f_0$, $3f_0$ offset, >+13 dBm ≤+13 dBm	-30 -35	-30 -35	-30 -35	-25 -35	N/A N/A
Harmonic (6071A) f_0, $2f_0$, $3f_0$ offset, >+13 dBm ≤+13 dBm	-30 -35	-30 -35	-25 -35	-20 -35	N/A -25

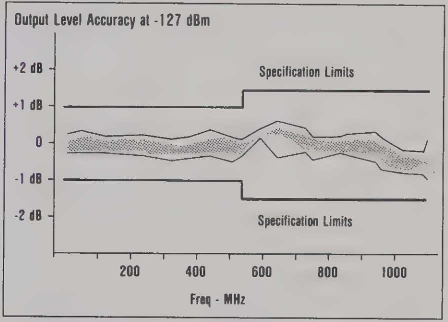
Output

Voltage Level Range: -140 dBm to +19 dBm for frequencies up to 520 MHz. Above 520 MHz (6071A), -140 dBm to +13 dBm
Resolution: 0.1 dB or 1% of voltage

Accuracy (dB)

Output	0.2 to 520 MHz	520 to 1040 MHz
+19 to +13 dBm +13 to -127 dBm	±1.0	N/A ±1.5

20°C ±5°C



Typical amplitude data measured at -127 dBm. 75% of the units measured within the shaded area. The outer lines represent worst-case measurements.

Output Impedance: 50 ohms, nominal

SWR

Output Level	0.2 to 520 MHz	520 to 1040 MHz
≥+7 dBm	2.0	2.5
<+7 dBm	1.5	2.0

Amplitude Modulation

AM Depth: 0 to 99.9% in 0.1% steps
AM Accuracy: (Internal or External)

Carrier Range	Modulation Frequency	AM Depth	Depth Accuracy
0.2 to 5 MHz	≤1 kHz	<90%	+5%, -8%
5 to 520 MHz	≤3 kHz	<90%	±5%
520 to 1040 MHz	≤3 kHz	≤70%	±5%

AM Distortion

Carrier Range	Modulation Frequency	AM Depth		
		0 to 30%	30 to 70%	70 to 90%
0.2 to 5 MHz	≤1 kHz	<2%	<5%	<7%
5 to 520 MHz	≤3 kHz	<1.5%	<3%	<3%
520 to 1040 MHz	≤3 kHz	<2%	<3%	<5%

AM Signal Bandwidth (-3 dB)

Current Range	AM Depth	Internal or External AC Coupled	External DC Coupled
0.2 to 5 MHz	≤70%	20Hz-8 kHz	DC-8 kHz
5 to 520 MHz	≤90%	20 Hz-50 Hz	DC-50 kHz
520 to 1040 MHz	≤70%	20 Hz-50 kHz	DC-50 kHz

Incidental FM (for 30% AM): 0.3 x modulation frequency for <520 MHz; 0.6 x modulation frequency for >520 MHz

6070A & 6071A

Frequency Modulation

Maximum Peak Frequency Deviation (kHz)

Frequency Range	ACFM the lesser of	DCFM the lesser of
0.2 to 62.5 MHz	999 or f_m x (520-f_o)	499
62.5 to 125 MHz	199 or f_m x f_o	f_o or 99.9
125 to 250 MHz	499 or f_m x f_o	f_o or 199
250 to 520 MHz	999 or f_m x f_o	f_o or 499
520 to 1040 MHz	999 or f_m x f_o	f_o or 999

f_o + Output frequency in megahertz
f_m + Modulation frequency in kilohertz

FM Deviation Resolution: 100 Hz for <100 kHz deviation; 1 kHz for 2100 kHz deviation
FM Deviation Accuracy: (Internal or external) ±10% at 400 Hz or 1 kHz modulation rate; ±13% at 0.3 to 50 kHz modulation rate (including flat ness)

FM Total Harmonic Distortion

Output Frequency Range	DCFM Mode Off and High Deviation: Off 0.5%+	DCFM Mode Off and High Deviation: On	DCFM Mode On 0.5%+
0.2 to 62.5 MHz	0.75% per 100 kHz dev	1.5 %	1.2% per 100 kHz dev
62.5 to 125 MHz	3.0% per 100 kHz dev		(600 ÷ f_o) % per 100 dev
125 to 250 MHz	1.5% per 100 kHz dev		
250 to 520 MHz	0.75% per 100 kHz dev		
520 to 1040 MHz	0.375% per 100 kHz dev		

f_o = Output frequency in megahertz

FM Signal Bandwidth (-3 dB): 20 Hz to 250 kHz internal or ac coupled external. Dc to 250 kHz dc coupled external
Center Frequency Accuracy (DCFM Off): Same as reference oscillator

Center Frequency Accuracy (DCFM On)*

Output Frequency Range	Initial Accuracy	Typical Stability
0.2 to 62.5 MHz	±1 kHz	50 Hz/min
62.5 to 125 MHz	±250 Hz	12.5 Hz/min
125 to 250 MHz	±500 Hz	25 Hz/min
250 to 520 MHz	±1 kHz	50 Hz/min
520 to 1040 MHz	±2 kHz	100 Hz/min

**Auto-CAL upon initialization*

Incidential AM: ≤0.5% (-52 dBc) for deviations up to 50 kHz at 1 kHz rate (single sideband) component referred to sinewave modulation

Phase Modulation

Deviation and Distortion

Output Frequency Range	Max Peak Deviation Radians	Total Harmonic Distortion Per Radian of Deviation With High Deviation Mode: Off	Total Harmonic Distortion Per Radian of Deviation With High Deviation Mode: On
0.2-62.5 MHz	99.9	0.5+($0.75 \times 10^{-5} x f_m$)%	1.5 %
62.5-125 MHz	19.9	0.5+($3.0 \times 10^{-5} x f_m$)%	
125-250 MHz	49.9	0.5+($1.5 \times 10^{-5} x f_m$)%	
250-520 MHz	99.9	0.5+($0.75 \times 10^{-5} x f_m$)%	
520-1040 MHz	99.9	0.5+($0.375 \times 10^{-6} x f_m$)%	

f_m = Modulation frequency in hertz

øM Resolution: 0.01 radian for <10 radians, 0.1 radian for 210 radians
øM Deviation Accuracy: (Internal or external) ±10% at 400 Hz or 1 kHz modulation rate; ±13% at 0.3 to 3 kHz modulation rate (including flatness)
øM Signal Bandwidth (-3 dB): 0.02 to 12 kHz internal or ac coupled external. Dc to 12 kHz external dc coupled
Incidental AM: ≤0.5% (-52 dBc) for devations up to 50 radians at a 1 kHz rate (single sideband component referred to sinewave modulation)

Modulation Signal Source

Modes: AM, FM, øM, AM + FM, AM +øM
Range: 0.02 kHz to 200 kHz
Frequency Accuracy: ±3% for 20°C to 30°C ambient temperature range. Add 0.1% per degree C outside that range
Total Harmonic Distortion: <0.15% from 0.2 kHz to 100 kHz; <0.2% below 0.2 kHz and above 100 kHz
Output Level: 0V to 2V peak to peak into 600Ω Output Impedance: 600Ω, nominal via front panel BNC connector

External Modulation Input

Level: 1V peak for specified AM, FM, or øM accuracy
Impedance: 600Ω, nominal
Coupling: AC or DC

Switching Time

Frequency: <85 ms from last controller command (<35 ms for most small changes) until frequency has settled to within 100 Hz of final value. Applies to frequency changes only
Level: <50 ms from last controller command. Applies to level changes only

Frequency Sweep

Sweep Modes: Auto, Single, Manual
Sweep Functions: Symmetrical sweep, asymmetrical sweep, sweep speed
Data Entry: Sweep width, sweep increment
Sweep Speed: Approximately 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, per increment
Sweep Output: 0 to +10V, up to 1000-point stepped ramp. Available at front panel BNC connector
Penlift/Z Axis Blanking: TTL output level at rear panel BNC connector. High during sweep retrace and when sweep is off

Memory

Memory Functions: Store, recall, insert above, delete, top
Locations: 9 standard, volatile; Option-570 50 non-volatile. Front panel set-ups can be stored in each location and later recalled

Remote Programming

Interface: IEEE-488
Functions Controlled: All front-panel controls except line power switch and modulation out put amplitude (MOD OUT)
Status Indicators: Remote, Addressed, SRQ.
Interface Functions: SH1, AH1, T6, L3, SR1, RL1, DC1, DT1, C0, E2

Option Specifications

10 MHz Ovenized Oscillator (-130)

Aging rate <±5 x 10^{-10} per day after a 21-day warmup. Temperature effects: <±2 x 10^{-10}/°C

Non-Volatile Memory (-570)

50 locations; operational features same as standard features. Data is stored with built in battery when power is off

Rear RF Output (-830)

Type N rf output connector available on rear panel

Auxiliary RF Output (-831)

Greater than -18 dBm, available at rear panel BNC. Impedance, 50 ohms

Reverse Power Protection (-870)

Up to 50 watts from a 50 ohm source over 0.2 to 1040 MHz. Will withstand up to 50V dc

Pulse Modulation (-950)

Adds pulse modulation to 6070A only. Fast 25 rise/fall times with on/off ratio of 40 to 60 dB depending of carrier frequency

General Specifications

EMI: Meets MIL-STD 461A RE02 and CE03, and MIL-I-6181D Sections 4.3.1 and 4.3.2 for both narrowband and broadband tests. RF leakage: less than 3 μV is induced into a two-turn, 1 inch diameter loop 1 inch away from any surface and measured into a 50Ω receiver

Temperature: 0°C to 50°C, operating; -40°C to +75°C, non-operating

Relative Humidity: ≤95% to 25°C; ≤75% to 50°C

Altitude: 110,000 feet

Power: 100, 120, 200, 240V ac ±10% 47 to 63 Hz; 125 watts typical. For 400 Hz operation consult your Fluke representative

Size: 13.3 cm H x 43.2 cm W x 54.6 cm D from front panel to rear handle (5.25 in H x 17.0 in W x 21.5 in D)

Weight: 27.7 kg (61 lb)

Safety: CSA 556B certified

Included: Operator's manual, service manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

6070A Synthesized Sig Gen (0.2-520 MHz)	$18,900
6071A Synthesized Sig Gen (0.2-1040 MHz)	19,900

Options (for 6070A & 6071A)

-130 Ovenized Reference Oscillator	1200
-570 Non-Volatile Memory	550
-830 Rear RF Output	125
-831 Auxiliary RF Output	175
-870 Reverse Power Protection	280
-950 Pulse Modulation (6070A only)	4925

Accessories (Also see page 485)

Y6001 Rack Mount Kit inc 24" slides	295
Y9100 Attenuator, 55Ω, 6 dB, BNC	55
Y9101 Attenuator, 50Ω, 14 dB, BNC	55
Y9102 Attenuator, 50Ω, 20 dB, BNC	55
Y9103 50Ω Feedthru Termination, BNC	35
Y9111 3 ft (0.91m) 50Ω Cable, BNC to BNC	20
Y9112 6 ft (1.83m) 50Ω Cable, BNC to BNC	20
Y9308 Adapter, N to BNC, 50Ω	20
Y9315 Coaxial Cable, N male to N male left	75
Y9316 Cap, Non-shorting, BNC	10
Y9317 50Ω Termination, N	95

PM 21XX Modular GPIB Switching System	see page 380
PM 2122 50 Ω coaxial switch	see page 382
PM 2240 TestTeam Software	see page 374

Service & Support

Warranty

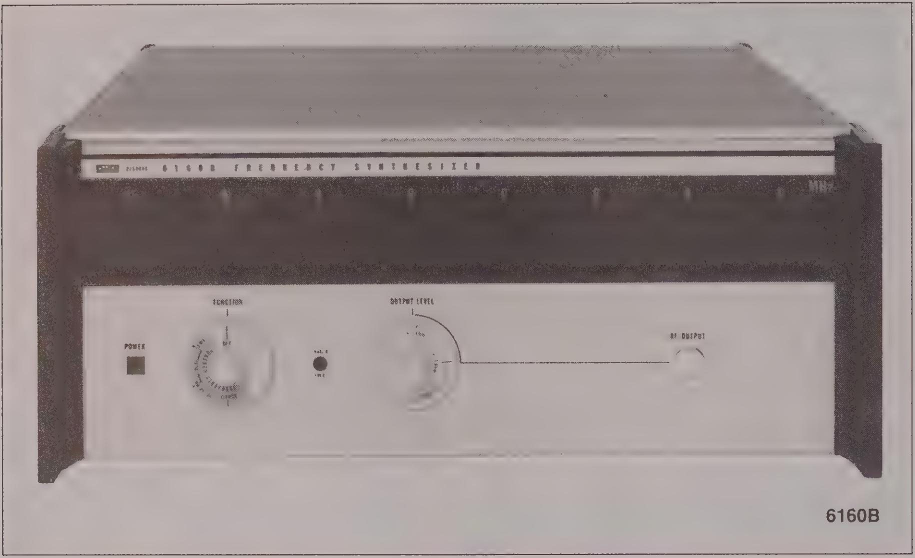
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-6070A Repair (w/calibration)	$ 598
SC1-6070A Repair (cal w/in or out data)	673
SC1-6070A Repair. (cal w/in and out data)	748
SC2-6070A Cal (1 per yr recommended)	495
SC2-6070A Cal (1 per yr w/in or out data)	570
SC2-6070A Cal (1 per yr w/in and out data)	645
SC1-6071A Repair (w/calibration)	667
SC1-6071A Repair (cal w/in or out data)	742
SC1-6071A Repair (cal w/in and out data)	817
SC2-6071A Cal (1 per yr recommended)	495
SC2-6071A Cal (1 per yr w/in or out data)	570
SC2-6071A Cal (1 per yr w/in and out data)	645

6160B

GPIB
IEEE-488



6160B

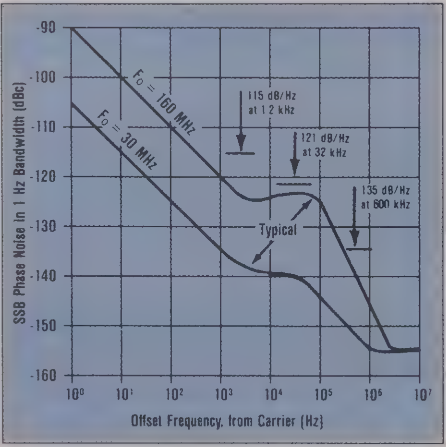
6160B Frequency Synthesizer

- High spectral purity: residual phase noise typically less than -74 dB
- Resolution: 0.1 Hz below 12 MHz; 1 Hz above
- Level flatness: ±1 dB into 50 ohms
- Switching speed: 800 µs
- Built-in BCD programming
- Optional GPIB/IEEE-488

The Fluke 6160B Frequency Synthesizer is the industry's most popular VHF synthesizer because of its high spectral purity. It produces frequencies from 1 MHz to 160 MHz in two ranges: 1 MHz to 12 MHz and 10 MHz to 160 MHz. Frequency resolution is 0.1 Hz on the 12 MHz range and 1.0 Hz on the 160 MHz range.

A unique feature of the 6160B is that the highest internally-generated frequency is that of the output VCO, i.e., 80 to 160 MHz. This makes servicing easier, and eliminates UHF EMC problems. Since the output VCO operates from 80 to 160 MHz, frequency division is employed for coverage of lower frequencies. This results in improved spurious specifications for frequencies lower than 80 MHz. Phase noise is similarly reduced for lower bands.

Built-in remote programming is DTL/TTL, BCD, positive true logic or by contact closures. Programming of frequency is via 34 parallel lines, and a remote flag and power flag are provided. Switching is fast, output level is electrically adjustable. Compatibility with GPIB/IEEE-488*-1978 is achieved using the Fluke 1120A Translator and 6XXXA-529 Interface.



The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

Specifications

Technical Specifications

Parameter		
FREQUENCY		
High Band Range **Minimum Step**	10 MHz to 160 MHz 1 Hz	
Low Band Range **Minimum Step**	1 MHz to 12 MHz 0.1 Hz	
Local Control **Remote Control**	Front panel rotary switches BCD per decade, TTL, DTL positive true logic or contact closures. Logic "0" = 0 to 0.9V dc. Logic "1" = 2V to +5V dc or open circuit.	
Spectral Purity* Non-Harmonic, Spurious	**MHz**	**dBc**
	1 to 20	-100
	20 to 40	-95
	40 to 80	-89
	80 to 160	-83
Harmonic, Spurious	<-25 dBc, typically <-30 dBc	
Amplitude Noise**	<-94 dBc (typical)	
Absolute Phase Noise**	<-62 dBc (typical)	
Residual Phase Noise**	<-74 dBc (typical)	
Phase Noise Spectral Density 1 Hz Bandwidth	**SSB Phase Noise**	**Offset from Carrier**
	1.2 kHz	<-115 dBc
	32 kHz	<-121 dBc
	600 kHz	<-135 dBc
OUTPUTS		
Main Output	Adjustable from +3 dBm to +13 dBm into 50Ω (0.3V to 001V rms) with front-panel control or external dc voltage. Level maintained ±1 dB into 50Ω	
Other Outputs	5 MHz at nominally 1V rms into 50Ω	
Output Options	Rear Panel, Opt -04	

MISCELLANEOUS	
Reference Frequency	External, 5 MHz at 0 dBm to +16 dBm into 50Ω
Level Control	External, 0.1 to 0.8V dc nominal into >2 kΩ produces an output level change of from +3 dBm to +13 dBm
Switching Speed	<800 µs to be within 50 Hz of final frequency (applies for frequencies from 80 MHz to 160 MHz. Improves at lower frequencies)
Internal 5 MHz Frequency Option -02, -05, or Other Source	**Option** **Aging Rate** -02 ±2 x 10^{-9}/day -05 ±5 x 10^{-6}/yr **Temp. Stability** 1 x 10^{-8}, 0°C to 50°C 1 x 10^{-6}, 0°C to 50°C

**Noise specifications are for frequencies from 80 MHz to 160 MHz. Noise performance improves or lower frequencies.*

*** Measured in a 30 kHz band excluding the 1 Hz band centered on the signal frequency.*

General Specifications

Altitude: To 3048 meters (10,000 feet), operating; 15,240 meters (50,000 feet), non-operating

Temperature: 0°C to 50°C, operating; -62°C to +70°C, non-operating

Relative Humidity: ≤80% to 50°C

Power: 115V or 230V ac ±10%, switch-selectable, 50 to 440 Hz. 80W

Size: 48.3 cm W x 17.8 cm H x 50.8 cm L (19 in x 7 in x 20 in)

Weight: 20.5 kg (45 lb)

Included: Manual, power cord, mating connector for programming input lines, serialized and dated calibration certificate

Ordering Information

Model

January 1989 prices

6160B* Frequency Synthesizer	$9950

Options (for 6160B)

-02* Frequency Std. 2x10^{-9}/day	1030
-04 Rear Panel RF Output	60
-05* Frequency Std. 5x10^{-6}/year	480
-522K 1120A Interface, field installable	325
-529** IEEE-488 Interface	380

** Option -02, -05 or an external 5 MHz timebase is required. Option -02 and -05 Frequency Standards are installable at Factory*

*** Requires 1120A IEEE-488 Translator. Includes 6XXXA-522K and Y7205 Cable*

Accessories (Also see page 485)

1120A IEEE-488 Translator	590
Y7205 6 ft Ribbon Cable for -522K	75
Y9111 3 ft (0.93m) 50Ω BNC Cable	20
Y9112 6 ft (1.85m) 50Ω BNC Cable	20
M07-205-600 7" Rack Adapter	110
M00-280-610 24" Rack Slides (Rack Adapter required)	130

Service & Support

Warranty

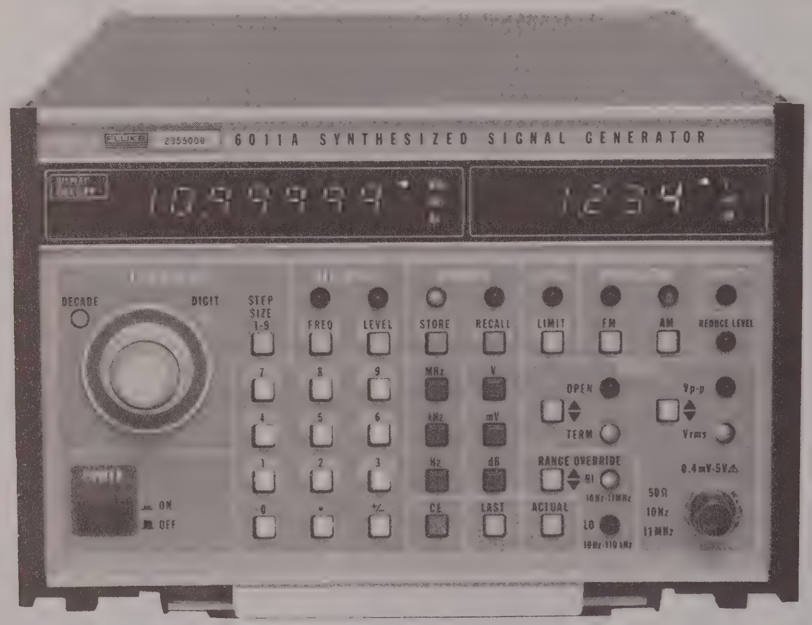
One-year product warranty. See page 470 for further information on warranty terms and conditions.

SC1-6160B Repair (w/calibration)	375
SC1-6160B Repair (cal w/in or out data)	410
SC1-6160B Repair (cal w/in and out data)	445
SC2-6160B Cal (1per yr recommended)	63
SC2-6160B Cal (1per yr w/in or out data)	98
SC2-6160B Cal (1 per yr w/in and out data)	133

6011A

GPIB
IEEE-488

RS-232



(NSN 6625-01-049-7760) **6011A**

6011A Signal Generator

- 0.1 Hz (7-digit) resolution to 110 kHz; 10 Hz resolution to 11 MHz
- Storage of up to 9 different frequencies
- Residual noise -50 dBc
- Harmonics -35 to -50 dBc
- Level flatness = 0.05 dB
- Frequency switching 2 ms

The 6011A has an output impedance of 50 ohms (75 ohms optional) over the entire frequency range of 10 Hz to 11 MHz, selectable with 0.1 Hz (7-digit) resolution to 110 kHz, 10 Hz resolution to 11 MHz. Frequency is displayed using a 7-digit LED readout. The rms output voltage into a 50 ohm load ranges from 400 V to 5V or 10V rms into an open circuit or high impedance load. Referred to 1 milliwatt in a 50 ohm load, ranges from -55 dBm to <27 dBm.

The output may be in units of dBm, volts, or millivolts selected with 4-digit resolution using calculator-like front panel pushbuttons and displayed on LEDs. And the output level may be selected in terms of peak-to-peak voltage as well as rms voltage.

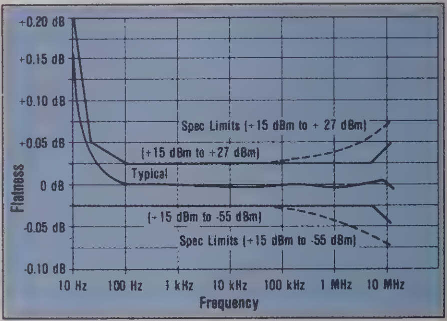
To avoid accidentally selecting an excessive output voltage, a limit may be stored in the 6011A. In addition, you may store up to nine different frequencies and/or output levels that may be recalled at random, quickly and without error — an important consideration for repetitive testing.

Selecting seven-digit frequency resolution is automatic — you don't need to select the high or low range or all seven digits when ending digits are zero. However, you may deliberately override the automatically-selected range when desirable.

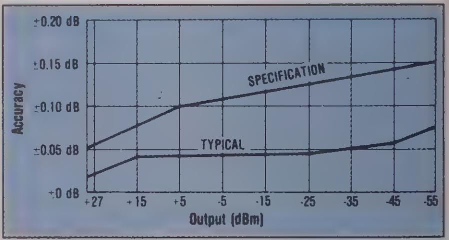
Any selected frequency may be increased or decreased in steps of practically any size, using the EDIT controls. This provides a manual sweep capability for checking frequency response, peaks, nulls, etc. A frequency or output level may be stored as a reference with other frequencies or levels added or subtracted within the instrument's range. This is useful for making relative measurements.

The 6011A can be controlled remotely and operate as part of a system. Option -05 makes the instruments compatible with GPIB/IEEE-488* and Option -06 gives them compatibility with EIA Standard RS-232-C. A seven-line ASCII bit-parallel interface is standard, when you don't order option -05 or -06. All front-panel functions are controllable remotely except for line power and open-terminated-load selection. The IEEE-488 Interface Option has the repertoire AH1, L2, RL1, and E1.

Output Level Flatness vs Frequency



Output Level Flatness vs Level



Specifications

Technical Specifications

Parameter	
FREQUENCY	
Low Range **High Range**	10 Hz to 109.9999 kHz 10 Hz to 10.99999 MHz
Range Selection	Automatic, with manual override
Resolution	0.1 Hz in the low range 10 Hz in the high range
Display	Seven-digit LED display of frequency set by local or remote control
Annunciation	Units automatically justified in the LED display to indicate maximum resolution

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

6011A

Accuracy	±3 parts in 10^6 for one year over the temperature range of 0°C to +50°C
Aging Rate	<1 part in 10^6 per day of 1 part in 10^6 per year at constant temperature
Temperature	<±2 parts in 10^6 from 0°C to +50°C. (<±5 parts in 10^7 from 0°C to +50°C with Option -01)
External Reference	Requires a 10 MHz TTL compatible square wave with symmetry between 40% and 60%. Internal reference is automatically selected in the absence of an external reference
Local Control	Keyboard selection of numerical data, magnitude (Hz, kHz, MHz) and functions. Edit control provided for modifying entry. 6011A programmable in steps of 1-9
Frequency Storage	Facility to store and recall 9 front-panel control settings including frequency, level, modulation, and output terminal parameters
Remote Control	ASCII standard. IEEE-488 or RS-232-C Optional
Switching & Settling Time	Frequency settles to within 10 Hz of final frequency in low range and 1 kHz in high range in <2 ms in fixed form <34 ms in free form (excluding recall)
SPECTRAL PURITY	
Harmonic, Spurious	-30 dBc from 10 Hz to 100 Hz -50dBc from 100 Hz to 1 MHz -40 dBc from 1 MHz to11MHz (Except -35 dBc for output levels within 2 dB of max output from 5 MHz to 11 MHz). Total harmonic distortion from 100 Hz to 110 MHz). Total harmonic distortion from 100 Hz to 110 kHz is <0.15% (typically 0.07%) on low range and 0.3% (typically 0.1%) on high range
Non-Harmonic, Spurious	All non-harmonically related outputs <-60 dBc below output or -110 dBm whichever is greater
Phase Noise	-46 dBc as measured in a 30 kHz bandwidth excluding 1 Hz centered on the carrier, including the effects of the internal standard. Residual (excluding internal standard) is <-50 dBc. Approximately 8 dB improvement on low range
Phase Noise Spectral Density (Typical)	SSB Phase Noise at the output measured in a 1 Hz bandwidth at max output. Approx. 10 dB improvement on low range **Offset from Carrier** — **SSB Phase Noise** 20 Hz — -102 dBc 200 Hz — -108 dBc 20 kHz — -106 dBc 1 MHz — -130 dBc

AMPLITUDE	
Impedance	50Ω (75Ω w/Option -10)
Range: dBm Volts	+26.98 dBm to -55.01 dBm into 50Ω 5.000V rms to 0.3972 mV rms into 50Ω
Local Control	Keyboard selection of output level in V, mV or dBm, Voltage is selectable in terms of V rms or V p-p and terminated or open circuit. Rotary knob provided for modifying entry and is programmable in steps of 1 through 9
Resolution	0.01 dB
Accuracy	See Graph
Frequency Response	See Graph
Stability vs. Temp	Typical temperature coefficient is 0.003 dB/°C, 20°C to 30°C ±0.2 dB, 0°C to 50°C
Switching & Settling Time	To within: ±1 dB, 150 ms fixed form, ±0.1 dB, 300 ms fixed form, ±0.01 dB, 450 ms fixed form. (Add 200 ms for free form.)
Display	dB; 4-digit LED plus sign in dBm or dB with respect to a stored dBm reference. Volts: 4-digit in V p-p or V rms; open circuit or terminated or volts or dB with respect to a stored voltage reference
AM Modulation	Analog input can be used to provide amplitude modulation. Bandwidth of this input is 10 kHz and max modulation is 90%. Z in = 600Ω 9V p-p corresponds to 90% modulation
Remote Control	ASCII standard. IEEE-488 or RS-232-C Optional
REMOTE INTERFACES	
Standard	Byte serial, bit parallel, seven ASCII-defined parallel lines, plus two handshake lines. Mating Connector Amphenol 57-30240. Also Option -05 and -06
OUTPUTS	
TTL Output	TTL-compatible square wave output (<0.5V to >2.4V p-p into 50Ω) at the synthesized output frequency
Reference Outputs	Derived from the synthesizer frequency reference. 1 MHz output is standard; 5 or 10 MHz available by changing internal jumper. Output is TTL-compatible square wave
Rear Panel Output	Option -04
20 to 31 MHz Tracking	Option -09

Option Specifications

High Performance TCXO Option (-01)

Frequency Accuracy: ±1.5 parts in 10^6 for one year over the temperature range of 0°C to +50°C
Aging Rate: <1 part in 10^8 per 24 hours at constant temperature, or 1 part in 10^6 per year
Temperature Dependence: <±5 parts in 10^7 from 0°C to +50°C

Phase-Lockable Input Option (-02)

Input Frequency: 1, 2, 2.5, 5, or 10 MHz
Input Level: >100 mV, <5V rms into 50Ω. May be used with either the standard oscillator or Option -01. Locking range is ±5 parts in 10^6 from frequency of internal oscillator

Frequency Modulation Option (-03)

General	High Range	Low Range
Deviation	±20 kHz	±200 Hz
Input	1V for 4 kHz ±5V max	1V for 40 Hz ±5V max
Accuracy 0 to 50°C	±1.5 kHz	±15 Hz
Rate	dc to 10 kHz	dc to 10 kHz
Linearity at Constant Temp	±1 kHz	±10 Hz
Stability at Constant Temp	±400 Hz	±4 Hz
Incidental AM Typical	<1%	<0.5%
Impedance, Input	600Ω	600Ω

IEEE-488 Interface Option (-05)

Compatible with IEEE Std 488-1978 for use in instrumentation systems. Interface functions are AH1, L2, RL1, and E1

RS-232-C Interface Option (-06)

Bit serial interface compatible with EIA Standard RS-232-C. Asynchronous data rates from 110 to 9600 baud. Either voltage-level interface or 20 mA current loop. 32-character FIFO buffer

General Specifications

Altitude: To 3048 meters (10,000 feet) operating
Temperature: 0°C to 50°C, operating; -40°C to 75°C, non-operating
Relative Humidity: ≤80% to 50°C
Power: 15V or 230V ac ±10%, 50 to 60 Hz, 100W, standard. Also 50 to 400 Hz optional and 100V ac optional
Size: 13.3 cm H x 21.6 cm W x 48.2 cm D (5.25 in x 8.5 in x 19 in)
Weight: 11.4 kg (25 lb)
Safety: CSA 556B certified
Included: Instruction Manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

6011A Synthesized Signal Generator	$6495

Options (for 6011A)

-01 High Performance TCXO	380
-02[1] Phase Lock Input	380
-03*[1] Frequency Modulation	1000
-04* Rear Panel Output	35
-05*[2] IEEE-488 Interface	365
-06*[2] EIA Standard RS-232-C Interface	665
-07 50-400 Hz Line Power	495
-08 100V, 50-60 Hz Line Power	375
-09 20-31 MHz Tracking Output	60

**Options -01, -02, -07, and -08 are installed at factory or service center only. Order -03K, -09K, -05K, or -09K kits for customer installation*

[1] Cannot have -02 and -03 options together

[2] Cannot have -05 and -06 options together

Accessories (Also see page 485)

Y9111 3 ft (0.93m) 50Ω BNC to BNC Cable	$20
Y9112 6 ft (1.85m) 50Ω BNC to BNC Cable	20
M05-203-601 5-1/4" Rack Adapter, Offset	130
M05-203-602 5-1/4" Rack Adapter, Centered	130
M05-200-603 5-1/4" Rack Adapter, Dual	115
M00-203-631 5-1/4" Rack Adapter, w/18" Slides	295
PM 21XX Modular GPIB Switching System	see page 380
PM 2122 50 Ω coaxial switch	see page 382
PM 2240 TestTeam Software	see page 374

Service & Support

Warranty

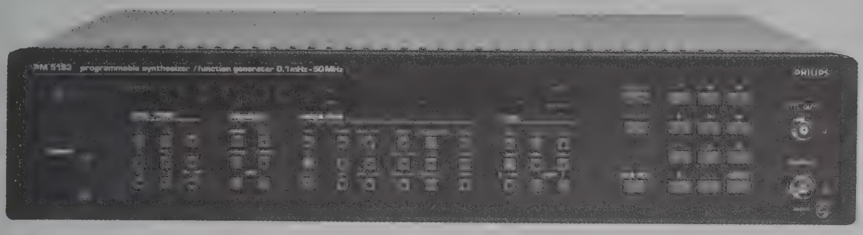
One-year product warranty. See page 470 for further information on warranty terms and conditions

Extended Warranty

SC1-6011A Repair (w/calibration)	398
SC1-6011A Repair (cal w/in or out data)	473
SC1-6011A Repair (cal w/in and out data)	548
SC2-6011A Cal (2 per yr recommended)	208
SC2-6011A Cal (2 per yr w/in or out data)	358
SC2-6011A Cal (2 per yr w/in and out data)	508

PM 5193

GPIB
IEEE-488



PM 5193

PM 5193 50 MHz Programmable Synthesizer/Function Generator

- 8 standard waveform outputs (operator programmable)
- Wide 0.1 mHz to 50 MHz frequency range
- Maximum 20Vpp output plus TTL output
- Completely independent AC and DC settings
- Full 8-digit resolution with clear, unambiguous LED readout panel
- Remote control of all programmable functions via GPIB/IEEE-488 interface
- Comprehensive modulation facilities including FM, AM, GATE, SWEEP, BURST

Wherever a high-stability, high-reproducibility frequency and function generator is required for testing, production control or driving frequency-dependent equipment, the PM 5193 is an unbeatable choice. Its versatile capability for generating standard functions, plus a broad frequency range extending from 0.1 mHz to 50 MHz, cover the requirements of virtually every situation.

The PM 5193 is today's most cost-effective multi-functional combination of programmable frequency synthesizer and function generator.

11-1/2 Decade Frequency Range

The frequency range of the PM 5193 covers a full 11-1/2 decades, from 0.1 mHz to 50 MHz. And to make working with this high-precision instrument as simple as possible, no less than 8 different waveforms are directly selectable. That includes standard functions like sine, squarewave, sawtooth and ramps, as well as important extras like pulse; both positive and negative; and haversine.

Instantly Selectable Modulation Modes

All required modulation modes are also instantly available at the touch of a button, covering AM, FM, sweep, burst and gating. Parameters like start and stop frequencies, amplitude and DC offset are easily programmable. And up to 10 complete front panel settings can be stored in non-volatile memory for instant recall whenever they are needed.

Precision and Stability

High precision and stability are essential factors in an instrument of this class. A crystal oscillator serves as a reference standard for all generated frequencies and provides an extremely high standard of accuracy. This feature, together with outstanding long-term stability ensures the extremely high level of repeatability that is one of the fundamental characteristics of the PM 5193.

Frequency resolution is a full 8 digits, so that advantage can be taken of the PM 5193's inherently high precision; useful in the identification and measurement of phenomena occurring at precisely defined frequencies.

GPIB Compatibility

Full GPIB/IEEE-488*/IEC-625 bus compatibility adds an important extra dimension to the PM 5193's versatility. All functions are remotely selectable, and all settings and status data can be transmitted to a remote controller and recalled whenever required.

The PM 5193 combines powerful user-features combined with operational simplicity. The front panel is divided into clear, separate keypad areas, and three informative LED displays show frequency, modulation parameters, output level and status, at a glance.

Local Button

The Local button provides a remote lock-out facility, so that manual changes can be made to current settings.

Waveform Selection

The Waveform keypad area allows selection of the PM 5193's 8 standard waveforms: sine, pulse (positive and negative), squarewave, haversine, triangle and sawtooth (positive and negative). The additional AC off button switches-off AC components, so that only the DC offset of a waveform (where selected) is output.

All buttons have an LED indicator to show at a glance which functions are selected, as well as to provide a warning of functions for which entries are incomplete.

Waveform Output Levels

Key symbol	Waveform	Max. frequency	Output Vpp (open loop)
∿	Sine	50 MHz	0...20
⎍	Positive pulse	50 MHz	1...10
⎎	Negative pulse	50 MHz	1...10
⊓	Squarewave	20 MHz	2...20
∿	Triangle	200 kHz	0...20
∧	Haversine	50 kHz	0...10
◸	Positive sawtooth	20 kHz	0...10
◺	Negative sawtooth	20 kHz	0...10

Frequency Selection

The frequency keypad area is used for precise programming of all frequency-related settings, including continuous wave frequencies, sweep start and stop frequencies, choice of Hz/kHz, and Δ frequency programmable step widths for discrete frequency steps. The preset frequency steps can then be repeated manually in either direction using the step + or - buttons.

Start and stop frequency values are programmed via the numeric keyboard, where they are input using the Enter button. The rub out key in the numeric keypad allows values to be corrected before entry.

The maximum frequency resolution is 0.1 mHz, and a total resolution of 8 digits is always available.

Sweep Modes

The PM 5193 has several sweep capabilities for testing, in a broad range of applications such as PHase Lock Loops, Amplifiers, IF units, Filters etc. All sweep parameters are programmed via the keyboard, for example start frequency, stop frequency, sweep time, linear or logarithmic, and single or continuous sweep. There are 3 sweep modes - in each case, the output waveform is shown for single shot and continuous.

The PM 5193 can be programmed to have the start frequency higher than the stop frequency or vice versa (see figure 1). For single shots, when the stop frequency is reached, the output remains at the stop frequency with no flyback until the "single" key (t_1) is pressed. The continuous sweep is the same as in sweep

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

mode 1 (See figure 2). As the figures demonstrate, in this mode a complete sweep takes double the programmed sweep time (See figure 3). With these three sweep modes you have more than 20 sweep possibilities. Sweep range is from 1 Mhz to 50 MHz with times programmable between 10 ms...999 s.

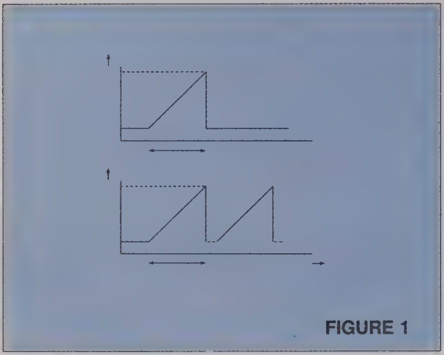


FIGURE 1

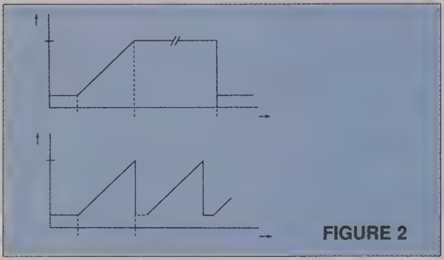


FIGURE 2

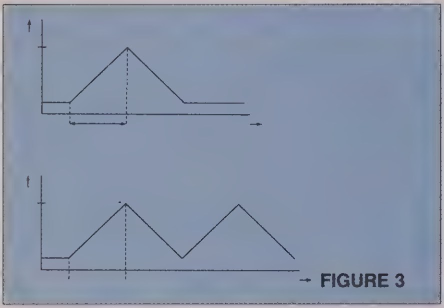


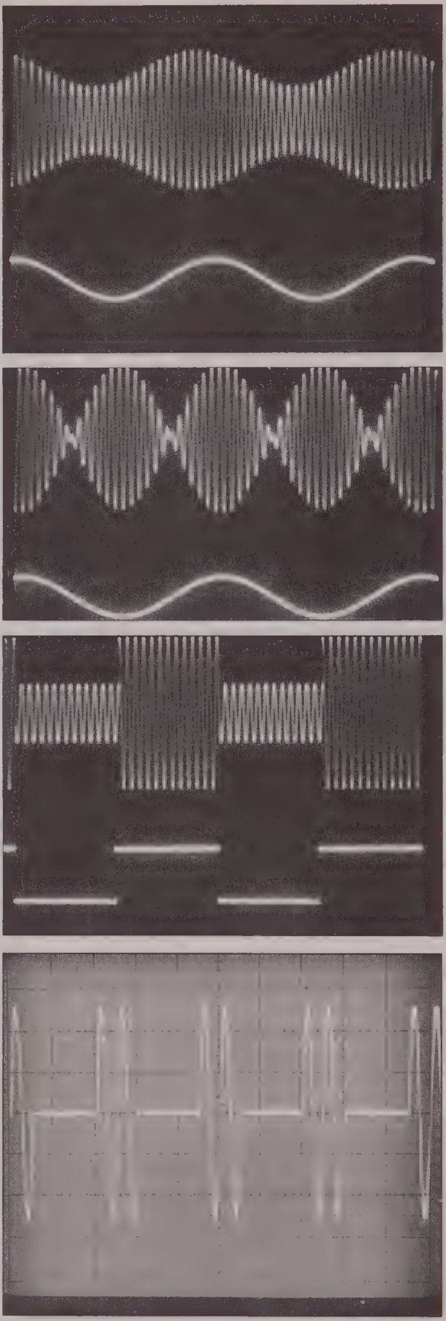
FIGURE 3

Modulation Modes

The PM 5193 has various modulation modes such as AM, FM, burst etc., including AM internal and AM external.

In AM external mode the carrier can be modulated with a frequency between DC and 200 kHz. This DC coupled modulation input allows modulation of the carrier not only with a sinewave but also with a square wave, triangle or superposed sine. With a superposed sinewave (DC + -1,4 Vn generate Amplitude Modulation with suppressed carrier.

The carrier can also be modulated with an external square wave, giving pulse modulation. On-off amplitude ratio is adjusted using the external square wave.



Burst signal, programmable on/off cycles; 2 on, 3 off cycles.

Output Level Setting

Selection of output levels in Vpp, Vrms or dBm is by means of a special keypad, and the selected output voltage is shown on the 3-digit LED display. The step function (Δ level) allows quick output-level changes in user defined steps. The nominal maximum outputs are waveform-dependent (see table).

Signal outputs, including a TTL output, are short-circuit-proof and located on the front panel.

Specially developed circuitry prevents any interaction between AC and DC settings within a ±10V window. These settings are therefore independent of each other within this window. A warning is given by a flashing key LED if any combined AC + DC setting exceeds the maximum preset output level.

Store and Recall Functions

The store and recall buttons allow up to 10 complete front panel settings to be stored and recalled at any time. The last front panel setting is automatically stored under '0', so that work can conveniently be resumed with the same settings in the next session. Up to nine additional settings can be stored in locations 1 - 9. Settings are stored in a non-volatile memory with battery back-up, providing assured storage over an extended period.

Wide Choice of Waveforms and Modulation Modes

Setting of the outputs is fast, simple and extremely logical using one set of pushbuttons grouped into four function fields for waveform, frequency, modulation and ouput characteristics, plus a common keyboard for entry of numeric values. Each function key has a built-in LED to indicate activation.

All the selected values are displayed on a bright, clear LED display for immediate and unambiguous readout showing frequency (8 digits), modulation parameter (4 digits) and output level or DC offset (3 digits).

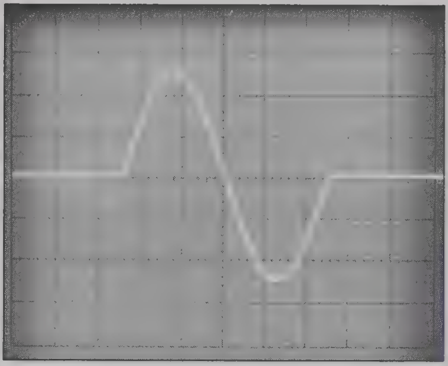
Function selection can also be done remotely, for example from a system controller, through the built-in IEEE-488/IEC-625 interface. When the IEEE-488/IEC-625 bus facility is in use, the relevant address can be shown in the 3-digit LED display.

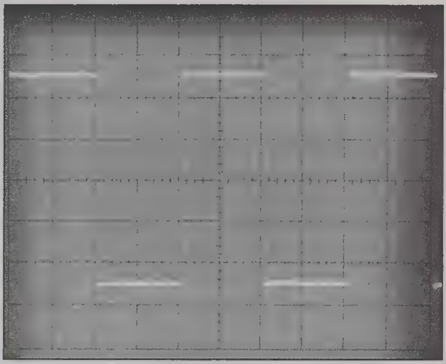
PM 5193's built-in capability to operate as a programmable "stand-alone" continuous wave pulse generator adds more versatility in everyday operation. Frequency range in this mode is up to 50 MHz, with a typical rise and fall time of 3 ns. The pulse generator can be programmed for positive or negative pulses, and the duty cycle is fixed at 50%.

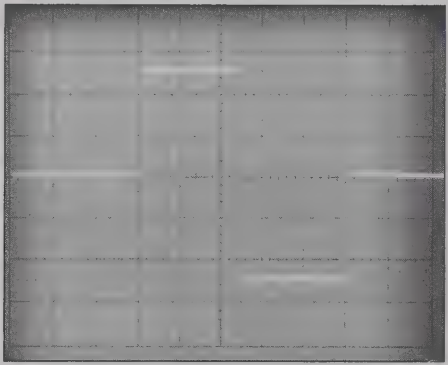
Other features include AC output dimensions selectable as Vpp, Vrms or dBm; phase-continuous sweep over all 10 frequency decades; independent AC and DC settings; and a TTL output conveniently located on the front panel.

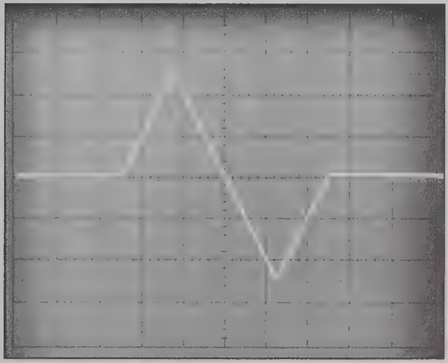
IEEE-488 Address Setting

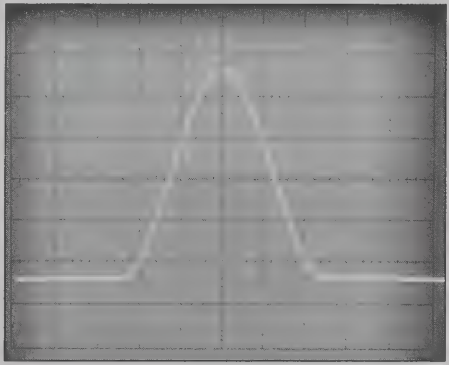
Setting of an IEEE-488 system address is carried out very conveniently by a direct-entry keyboard, instead of the usual DIP switches (which in many cases are inaccessibly located on a rear panel or inside the instrument cabinet). With the PM 5193, all that is necessary is to activate the "address" key. The current address is then displayed, and a new address can be

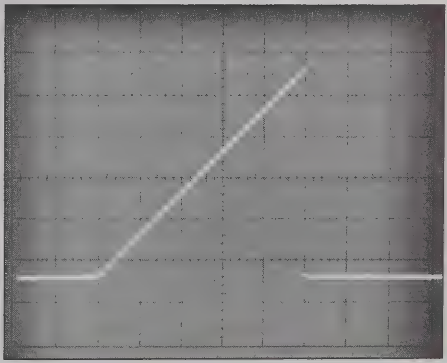

Sinewave


Positive and negative pulses with 3 ns transition time.


Squarewave


Triangle


Haversine (sine ^{2} signal)


Positive and negative ramps

programmed if required.

As well as the PM 5193's comprehensive standalone features, it also offers advanced facilities for operating within an automated testing system. This form of operation allows large numbers of automatic measurements to be performed continuously and with complete reproducibility, useful in quality control situations.

The instrument operates as a talker/listener, and can be remotely programmed for all manual and triggered functions, including SWEEP and (programmable) BURST. Moreover, the SERVICE REQUEST function can be generated to give error indications, END messages (e.g. for SWEEP and BURST in SINGLE SHOT mode).

A pushbutton-operated remote lock-out facility allows the user to lock-out the controller when making manual changes to the current setting. The IEEE-488 address is set via the numeric keyboard, and can be displayed on the 3-digit LED panel.

Learn and Identification Modes

PM 5193 has additional Learn and Identification modes to facilitate programming and operation in IEEE-488-bus environments.

Learn mode makes it possible to send a complete string of instructions representing any particular front panel settings to a controller. These settings can then be reproduced simply whenever required from the controller by the transmission of the corresponding string to the PM 5193. This mode reduces programming to a minimum, and contributes to the PM 5193's ease of integration into automated measuring systems.

In Identification mode, the PM 5193 automatically responds to an identification request from the controller by transmitting its type number and software version.

Rack Mounting Facilities

PM 5193 is supplied as standard with the necessary hardware for rack mounting, further increasing its flexibility in use. An optional RF output can also be supplied for rack-mounted system interconnection.

Rear Panel Connection Facilities

A number of additional connection facilities are provided on the rear panel of the PM 5193:

Inputs:

Ext clock: The PM 5193S can lock-on to external 10 MHz reference signals which are applied to this BNC connector. The PM 5193 can lock onto external reference signals from other PM 5191/5192/5193 generators (8.6 MHz).

Modulation: The PM 5193's wide range of external modulation modes can be used by applying the modulation signal to this BNC connector.

Outputs:

Int. clock: The reference frequency of (10 MHz or 8.6 MHz) is available at the int. clock connector. This frequency can be used for synchronization purposes.

Modulation: The signal output from the PM 5193's programmable modulation frequency source is available on this socket for triggering purposes.

Penlift + sweep: These two signals enable the PM 5193 to be connected directly to an X-Y recorder, for example for plotting the frequency response characteristics of filters.

IEEE-488 connector: For direct connection of the PM 5193 into IEEE-488-bus-oriented measuring systems. The shielded IEEE-488 connector provides optimal security against disturbance of IEEE-488 data.

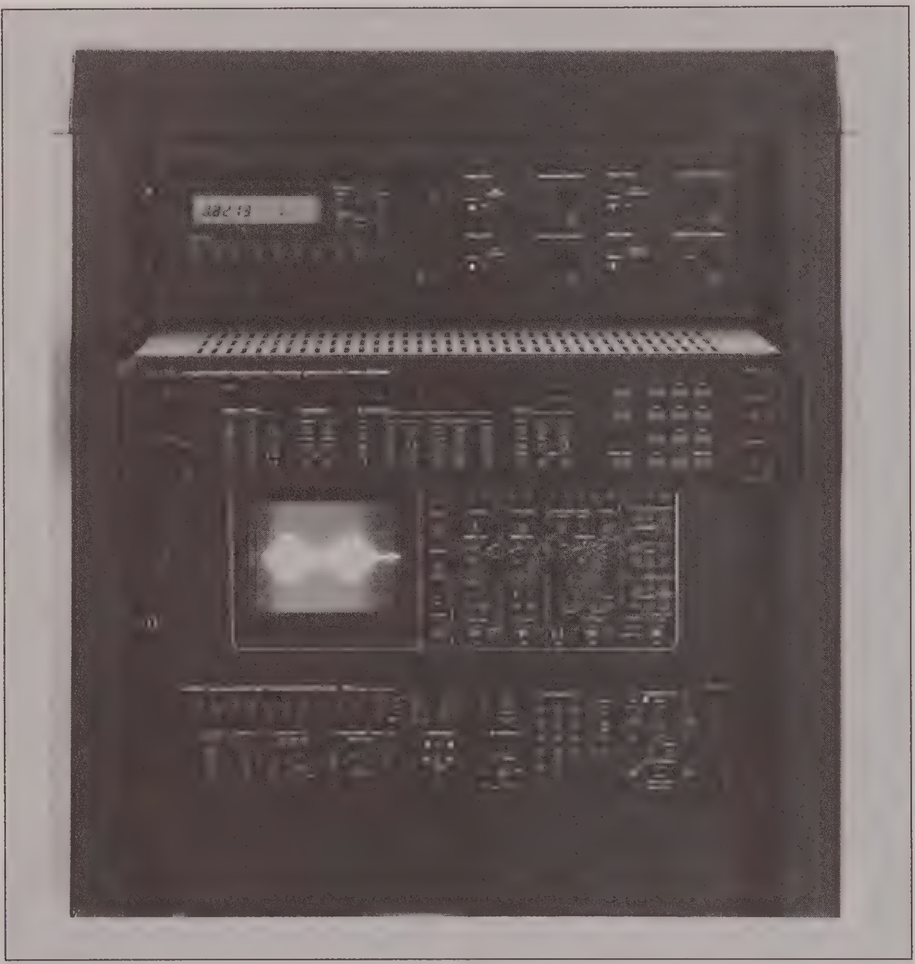
Specifications

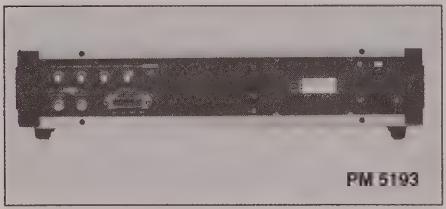
Technical Specifications

Frequency Characteristics

Nominal Range: 0.1 mHz - 50 MHz
Operational Range: Sinewave 50 MHz;
Positive pulse 50 MHz
Negative pulse 50 MHz
Squarewave 20 MHz;
Triangle 200 kHz;
Haversine 50 kHz
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz

PM 5193





Setting: Local via front-panel keyboard. Remote via IEEE-488 bus interface ± stepping function with programmable step width
Resolution: 8 digits; >0.1 mHz
Display: 8-digit LED display, Hz/kHz dimension LEDs
Setting Error: <1 x 10^{-6}
Frequency Jitter: <0.02% <1200 Hz f ≥2 MHz LF bandwidth 10 Hz - 20 kHz
Temperature Coefficient: <0.2 p.p.m./K
Aging: <1 p.p.m. per year
Drift: <0.3 p.p.m. in 7h

Output Characteristics

Main Output
Connector: BNC socket on front or rear panel
Impedance: Z_o +50Ω
Load Capability: Short-circuit proof
Max. External Voltage: ±12 Vpp (<3 min.)

AC Voltage
Independent of DC settings within ±10V window
Ranges: I 2.1 - 20 Vpp open-circuit voltage;
II 0.21 - 2.00Vpp open-circuit voltage;
III 0 - 0.200Vpp open-circuit voltage
Resolution: Range I 0.1V; Range II 0.01V; Range III 0.001V
Setting: Remote or local +/- stepping
Programmable step width
Alternative Settings: Vrms, dBm
Basic Setting Error: ±2% (1 Hz - 200 kHz) Vpp >2.1V

DC Voltage
Independent of AC setting within ±10V window
Range: ±10V open-circuit voltage
Resolution: 0.1V
Error: ±2% of setting
Offset: <0.03V (Vac ≤2V);
<0.08V (Vac >2V)
Setting: Remote or local; +/- stepping function. Programmable step width

TTL Output
Connector: BNC socket on front panel
Fan-Out: <5 TTL inputs
Level: 0/>3.5V

Waveforms

Standard Functions: Sinewave, squarewave, triangle, haversine, sawtooth (positive- and negative-going ramps), positive and negative pulse
Selection: Local via front panel keyboard. Remote via IEEE-488 bus interface
Indication: Key LEDs

Sinewave
Frequency Range: 0.1 mHz...50 MHz
Output Range: 0...20 Vpp

Distortion
THD: <0.35% (1 Hz< f <200 kHz, open circuit voltage: <12 Vpp range I, <1.2 Vpp range II, <0.12 Vpp range III)
Harmonics: <-37 dBc (200 kHz< f <10 MHz, open circuit voltage ≥10 mVpp)
Spurious: <-40 dBc (2 MHz< f <50 MHz, open circuit voltage ≥100 mVpp, distance from carrier <15 kHz)
<-50 dBc (0.1 mHz< f <2 MHz, open circuit voltage ≥100 mVpp, distance from carrier >15 kHz)

Haversine
Frequency Range: 0.1 mHz...50 kHz
Output Range: 0...10Vpp
Distortion: <0.8% (output >10 mVpp)

Squarewave
Frequency Range: 0.1 mHz - 20 MHz
Transition Times: 10 ns typically, <11.5 ns
Duty Cycle: 50%
Abberration: <2% ±3 mV range II;
<2% ±20 mV range I

Triangle
Frequency Range: 0.1 mHz - 200 kHz
Output Range: 0 - 20 Vpp
Temperature Coefficient: <0.1%/K
Linearity: >99%

Sawtooth (pos/neg ramps)
Frequency Range: 0.1 mHz - 20 kHz
Output Range: 0 - 10 Vpp
Temperature Coefficient: <0.1%/K
Flyback Time: <1 +s
Linearity: <99%

Pulse
Frequency Range: 0.1 mHz...50 MHz
Output Range: 1.0...10Vpp
Rise/Fall Time: 3 ns (typically <4.5 ns)
Aberration: <2% ±40 mV

Modulation

Modes: AM int./ext., FM int./ext.,lin./log. sweep, gate int./ext., burst
Internal modulation frequency programmable via keypad
Resolution: Range I (0.01 - 0.99 kHz): 10 Hz
Range II (1.0 - 9.9 kHz): 0.1 kHz
Range III (10 - 200 kHz): 1.0 kHz

Internal AM
Carrier Frequency: 0.1 mHz - 50 MHz carrier wave: all except pulses
Modulation Frequency: 10 Hz...200 kHz
Modulation Depth: 0 - 100%
Resolution: 1%
AM Envelope Distortion: <2% (m ≤98%); <1.5% (m <50%)

External AM
Modulation Frequency: 0 - 200 kHz
AM Envelope Distortion: 1.5% (m <98%); 1% (m <50%)

Internal FM
Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz...200 kHz
Deviation: 10 kHz...200 kHz
Resolution: 1 kHz
Modulation Distortion: <1% (f ≤30 MHz; Δf ≤100 kHz; fm ≥200 Hz and ≤50 kHz)

External FM
Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz...200 kHz
Deviation: 10 kHz...200 kHz
Distortion: <1%

Sweep
Carrier Wave: All waveforms
Sweep Functions: lin./log., up/down, single/continuous, hold/release
Range: 1 mHz...50 MHz phase-continuous, depending on waveform; independent setting of start and stop frequencies
Sweep Time: 10 ms - 999s
Resolution: Max. 0.01s (3 digits)
Error: 0.1 ms

Internal Gate
Non-phase-coherent signal keying
Carrier Frequency: 0.1 mHz - 50 MHz (depending on waveform): carrier wave: all except pulses
Modulation Frequency: 10 Hz...200 kHz
Duty Cycle: 50%

External gate
Modulation Frequency: 0...500 kHz; min. on/off time 2 µs

Burst
Carrier Frequency: <2 MHz (depending on waveform) all carrier waveforms
On and Off Cycles: 1...200 programmable
Burst Functions: Single/continuous
External Triggering: TTL positive edge; via modulation input
Max. Frequency: 1 kHz

Video Modulation (PM 5193V only)
Carrier Waveform: sine
Carrier Frequency: ≤50 MHz
Modulation Bandwidth (-1 dB): ≥8 MHz; carrier frequency <45 MHz
External Modulation Signal: CVBS; amplitude: 1 Vpp
Max. DC Offset: ±5V
Modulation Mode: Double sideband amplitude modulation (A3F), negative polarity
RF Synchronizing Level: 100%
Residual Level (white level): 11 ±3%; related to RF synchronizing level
Independent Linearity Error: ≤2% between black and white level

Connector: BNC; "VIDEO IN" at rear of the instrument
Impedance: 75Ω

IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics
Interface Functions: AH1, L4, RL1, SR1, SH1, T6
Listener Address: Programmable via keyboard, indicated by LED display
Address Range: 0...30
Service Request: Error and single sweep end message
Remote Lock-Out: Go-to local front panel key
Device Identification and learn modes provided as standard

10 MHz Output (PM 5193S only)
Protection: Short-circuit proof, max. external voltage 10V
Frequency: 10 MHz (squarewave)
Level: Typ. 2 dBm >0 dBm
Impedance: 50Ω

External Reference Input (PM 5193S only)
Maximum Voltage: ±5V
Waveform: sine or square
Frequency: $\frac{10\ \text{MHz}}{N}$ N = 1, 2, 3...10 for synchronization purposes
Lock-In Time: <2s
Lock-In Range: ±0.1% - a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency
Level: 0 - 20 dBm
Impedance: 50Ω

General Specifications

Miscellaneous

Non-Volatile Memory: 1 memory location for last setting. 9 Memory locations for programmable settings.
Rear Connectors: Modulation output BNC; Sweep output BNC; Pen-lift output BNC; Clock output BNC; Modulation input BNC; Clock input BNC; IEEE-488 bus connector; Mains connector

Operating Conditions

Reference Temp.: +23°C ±1°C
Operating Temp.: +5°C...+40°C
Storage Temp.: -20°C...+70°C

Power Requirements

Line Voltage: 100, 120, 220, 240V, tolerance ±10%
Line Frequency: 50 - 60 Hz, tolerance ±5%
Power Consumption: 105W
Size: 105 mm H x 440 mm W x 430 mm L. (4.1 in H x 17.3 in W x 15.6 in L). Rack mounting facility standard (2 units high)
Weight: 10.5 kg (23 lb)
Included with instrument: Operating manual, programming card, rack mounting brackets

Ordering Information

Model

January 1989 prices

PM 5193M Programmable Synthesizer/Function Generator	$4600
PM 5193SM Programmable Synthesizer/Function Generator with 10 MHz Reference Input	4895
PM 5193VM Programmable Synthesizer /Function Generator with video modulation	5895

Option

Rear Panel Output	consult factory

Accessories (Also see page 485)

PM 9581/01 50Ω Feed-through Termination 3W	65
PM 9585/01 50Ω Feed-through Termination 1W	30
PM 2295/05 IEEE-488 Cable .5m	150
PM 2295/10 IEEE-488 Cable 1m	155
PM 2295/20 IEEE-488 Cable 2m	170
PM 2296/50 IEEE-488 to IEC-625 Adapter	70
PM 2296/60 IEC-625 to IEEE-488 Adapter	80
PM 9051 BNC to 4 mm Banana Adapter	9
PM 21XX Modular GPIB Switching System	see page 380
PM 2122 50 Ω coaxial switch	see page 382
PM 223X Instrument Drivers Software	see page 376
PM 2240 TestTeam Software	see page 374

Service & Support

Warranty
One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 5192

PM 5192

PM 5192 20 MHz Synthesizer/Function Generator

- Five standard waveform outputs
- Crystal-controlled precision and stability 0.1 mHz to 20 MHz frequency range
- Maximum 20 Vpp output plus TTL output
- Completely independent AC and DC settings
- Full 8-digit resolution with clear LED read out
- Remote control of all programmable functions via GPIB/IEEE-488 interface
- Modulation facilities include AM, FM, GATE, SWEEP

The PM 5192 is a precision frequency source with the assurance of long-term stability and reproducibility. A crystal oscillator serves as a reference for the generated frequencies, ensuring that the PM 5192 will always continue to provide the selected frequency to a very high standard of accuracy.

Setting error is negligible at <1 x 10-6, and the exceptionally low aging figure of <1 p.p.m/year makes the PM 5192's accuracy a true reference standard for applications in R & D, production-line testing and quality control, and many other fields of engineering.

The PM 5192's frequency range extends from 0.1 mHz to 20 MHz (actual range depends on selected waveform). Output voltages are continuously adjustable up to 20 Vpp, and can be expressed in Vpp, Vrms or dBm.

Frequency resolution is a full 8 digits, a figure that represents only 1 Hz in 20 MHz, allowing full advantage to be taken of PM 5192's very high precision, useful in the identification and measurement of phenomena occuring at precisely defined frequencies.

A choice of five different waveforms covers almost all standard-function requirements, with sine, square wave, triangle and sawtooth (positive- and negative-going).

The PM 5192's outstanding capabilities and precision are combined with an economic cost, making this instrument an attractive, general-purpose tool for a very wide range of different applications.

Programmable Parameters

Parameters like start and stop frequencies, amplitude and DC offset are easily and quickly programmed using the front panel keyboard. And for still more convenience and time saving, up to 10 complete front panel settings can be stored in non-volatile memory for instant recall whenever they are needed.

Also provided is a valuable sweep function, with independently programmable sweep parameters, allowing localization of areas of interest, followed by close examination of particular frequency bands of interest.

Compatibility

To increase versatility in use still further, the PM 5192 has full GPIB/IEEE-488* bus compatibility. All functions are remotely selectable via the bus, while settings and status data can be transmitted to a remote controller and recalled whenever required.

In this systems mode, large numbers of automatic measurements can be made continuously and with complete reproducibility, excellent for quality control applications. Manual setting changes can still be made using a push button-operated controller lock-out facility. IEEE-488 addresses are set via the numeric keyboard, and can be displayed on the LED display.

Waveform Selection

The waveform keypad area allows selection of PM 5192's 5 standard waveforms: sine, square wave, triangle and sawtooth (positive- and negative-going).

All buttons have an LED indicator to show at a glance which functions are selected, as well as to provide a warning of functions for which entries are incomplete.

Waveform Output Levels

Key symbol	Waveform	Max. frequency	Output Vpp (open loop)
∿	Sine	20 MHz	0...20
⎍	Square	20 MHz	0.2...20
∧∨	Triangle	200 kHz	0...20
◿	Positive sawtooth	20 kHz	0...10
◺	Negative sawtooth	20 kHz	0...10

Precise Frequency Programming

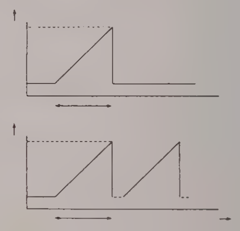
A frequency keypad area allows precise programming of frequency-related settings, including continuous wave frequencies, sweep start and stop frequencies, choice of Hz/kHz, and Δ freq. programmable for discrete frequency steps.

These preset frequency steps can then be repeated manually in either direction using the step + or - buttons.

Start and stop frequency values are programmed via the numeric keyboard, where they are input using the enter button. The rub-out key in the numeric keypad allows values to be corrected before entry. The maximum frequency resolution is 0.1 mHz, and a total resolution of 8 digits is always available.

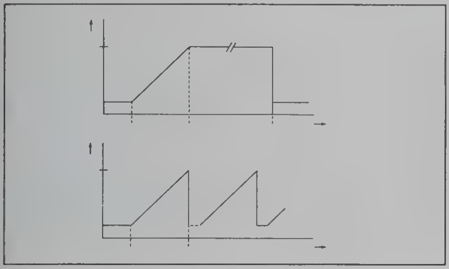
Sweep Modes

The PM 5192 has several sweep capabilities for testing, in a broad range of applications such as Phase Lock Loops, Amplifiers, IF units, Filters etc. All sweep parameters are programmed via the keyboard, for example start frequency, stop frequency, sweep time, linear or logarithmic, and single or continuous sweep. There are 3 sweep modes — in each case, the output waveform is shown for single shot and continuous.

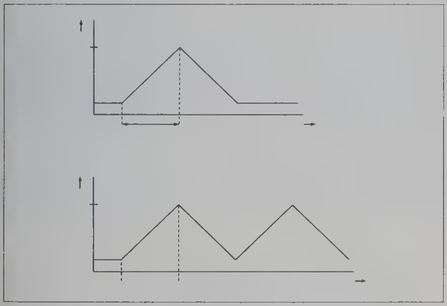


**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

The PM 5192 can be programmed to have the start frequency higher than the stop frequency or vice versa.



For single shots, when the stop frequency is reached, the output remains at the stop frequency with no flyback until the "single" key (t_1) is pressed. The continuous sweep is the same as in sweep mode 1.



As the figures demonstrate, in this mode a complete sweep takes double the programmed sweep time.

With these three sweep modes you have more than 20 sweep possibilities. Sweep range is from 1 MHz to 20 MHz with times programmable between 10 ms...999s.

Modulation Modes

The PM 5192 has various modulation modes such as AM, FM, burst etc., including AM internal and AM external.

In AM external mode the carrier can be modulated with a frequency between DC and 200 kHz. This DC coupled modulation input allows modulation of the carrier not only with a sinewave but also with a square wave, triangle or superposed sine. With a superposed sinewave (DC = -1.4V) you can generate Amplitude Modulation with suppressed carrier.

The carrier can also be modulated with an external square wave, giving pulse modulation. On-off amplitude ratio is adjusted using the external square wave.

Output Level Setting

Selection of output levels in Vpp, Vrms or dBm is by means of a special keypad, and the selected output voltage is shown on the 3-digit LED display. The step functions (Δ level) allows quick output-level changes in user defined steps. The nominal maximum outputs are waveform-dependent (see table).

Signal outputs, including a TTL output, are short-circuit-proof and located on the front panel.

Specially developed circuitry prevents any interaction between AC and DC settings within a ±10V window. These settings are therefore independent of each other within this window. A warning is given by a flashing key LED if any combined AC + DC setting exceeds the maximum preset output level.

Store and Recall Functions

The store and recall buttons allow up to 10 complete front panel settings to be stored and recalled at any time. The last front panel setting is automatically stored under '0', so that work can conveniently be resumed with the same settings in the next session. Up to nine additional settings can be stored in locations 1 - 9. Settings are stored in a non-volatile memory with battery back-up, providing assured storage over an extended period.

GPIB/IEEE-488 Address Setting

Setting of an IEEE-488 system address can be done locally, via the front panel. With the PM 5192, all that is necessary is to activate the 'address' key. The current address is then displayed, and a new address can be programmed if required.

Learn and Identification Modes

Learn and identification modes facilitate programming in system environments. In Learn mode, instruction strings for front panel settings can be up-loaded to a controller for later recall, avoiding the need for manual re-programming. In Identification mode, the PM 5192 responds to controller identification requests with its type number and software version. Rack-mounting fittings are supplied as standard, further increasing versatility in system environments.

Rear Panel Connection Facilities

A number of additional connection facilities are provided on the rear panel of PM 5192:

Inputs

Ext clock: PM 5192S can lock on to external reference signals (10 MHz) which are applied to this BNC connector.

The PM 5192 can lock on to external reference signals from other PM 5191/2/3 generators (8.6 MHz).

Modulation: External frequencies applied to this BNC connector can modulate the carrier in any of PM 5192's modulation modes (AM, FM, gating), or can be used for trigger purposes.

Outputs

Int. clock: The reference frequency (10 MHz or 8.6 MHz) is available at the int. clock connector. This frequency can be used for synchronization purposes.

Modulation: The signal output from PM 5192's programmable modulation frequency source is available on this socket for triggering purposes.

Penlift + Sweep: These two signals enable PM 5192 to be connected directly to an X-Y recorder, for example for plotting the frequency response characteristics of filters.

IEEE-488 Connector: For direct connection of PM 5192 into IEEE-488-bus-oriented measuring systems. The shielded IEEE-488 connector provides optimal security against disturbance of IEEE-488 data.

Specifications

Technical Specifications

Frequency Characteristics

Nominal Range: 0.1 mHz - 20 MHz

Operational Range:
Sinewave 20 MHz;
Squarewave 20 MHz;
Triangle 200 kHz;
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz

Setting: Local via front-panel keyboard. Remote via IEEE-488 bus interface +/- stepping function with programmable step width

Resolution: 8 digits; >0.1 mHz

Display: 8-digit LED display, Hz/kHz dimension LEDs

Setting Error: $<1 \times 10^{-6}$

Frequency Jitter: <0.01% <500 Hz f ≥2 MHz LF bandwidth 10 Hz - 20 kHz

Temperature Coefficient: <0.2 p.p.m./K

Aging: <1 p.p.m. per year

Drift: <0.3 p.p.m. in 7h

Synchronization: 2 (or more) PM 5192 generators can be synchronized by rear socket connection

Output Characteristics

Main Output

Connector: BNC socket on front or rear panel

Impedance: Z_0 +50Ω

Load Capability: Short-circuit proof

Max. External Voltage: ±12 Vpp (<3 min.)

AC Voltage

Independent of DC settings within ±10V window

Ranges: I 2.1 - 20 Vpp open-circuit voltage;
II 0.21 - 2.00V open-circuit voltage;
III 0 - 0.200V open-circuit voltage

Resolutions: Range I 0.1V;
Range II 0.01V;
Range III 0.001V

Setting: Remote or local +/- stepping
Programmable step width

Alternative Settings: Vrms, dBm

Basic Setting Error: ±2% (1 Hz - 200 kHz), range >2.1V

DC Voltage

Independent of AC setting within ±10V window

Range: +/- 10V open-circuit voltage

Resolution: 0.1V

Error: ±2% of setting

Offset: <0.03V (Vac ≤2V); <0.08V (Vac >2V)

PM 5192

Setting: Remote or local; +/- stepping function. Programmable step width

TTL Output
Connector: BNC socket on front panel
Fan-Out: <5 TTL inputs
Level: 0/>3.5V

Waveforms

Standard Functions: Sinewave, squarewave, triangle, sawtooth (positive- and negative-going ramps)
Selection: Local via front panel keyboard. Remote via IEEE-488 bus interface
Indication: Key LEDs

Sinewave
Frequency Range: 0.1 mHz...20 MHz
Output Range: 0...20 Vpp

Distortion
THD: <0.35% (1 Hz< f <200 kHz, open circuit voltage <12 Vpp range I, <1.2 Vpp range II, <0.12 Vpp range III)
Harmonics: <-37 dBc (200 kHz< f <10 MHz, open circuit voltage ≥10 mVpp)
Spurious: <-40 dBc (2 MHz< f <20 MHz, open circuit voltage ≥100 mVpp, distance from carrier >15 kHz); <-50 dBc (0.1 mHz< f <2 MHz, open circuit voltage ≥100 mVpp, distance from carrier >15 kHz)

Squarewave
Frequency Range: 0.1 mHz - 20 MHz
Transition Times: 10 ns typical, <11.5 ns
Duty Cycle: 50%
Abberration: <2% ±3 mV range II; <2% ±20 mV range I

Triangle
Frequency Range: 0.1 mHz - 200 kHz
Output Range: 0 - 20 Vpp
Temperature Coefficient: <0.1%/K
Linearity: >99%

Sawtooth (pos/neg ramps)
Frequency Range: 0.1 mHz - 20 kHz
Output Range: 0 - 10 Vpp
Temperature Coefficient: <0.1%/K
Flyback Time: <1 µs
Linearity: >99%

Modulation

Modes: AM int./ext., FM int./ext.,lin./log. sweep, gate int./ext. Internal modulation frequency 1 kHz programmable via keypad

Internal AM
Carrier Frequency: 0.1 mHz - 20 MHz
Modulation Frequency: 1 kHz
Modulation Depth: 0 - 100%
Resolution: 1%
AM Envelope Distortion: <2% (m ≤98%); <1% (m <50%)

External AM
Modulation Frequency: 0 - 200 kHz
AM Envelope Distortion: 1.5% (m <98%); 0.7% (m <50%)
Imp of Mod Source: ≤50Ω

Internal FM
Carrier Frequency: >2 MHz
Modulation Frequency: 1 kHz
Deviation: 10 kHz - 200 kHz
Resolution: 1 kHz
Modulation Distortion: <1% Δf ≤100 kHz

External FM
Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz - 200 kHz
Deviation: 10 kHz - 200 kHz
Distortion: <1%
Imp of Mod Source: ≤50Ω

Sweep
Carrier Wave: All waveforms
Sweep Functions: lin./log., up/down, single/continuous, hold/release, triggered
Range: 1 mHz - 20 MHz phase-continuous, depending on waveform; independent setting of start and stop frequencies
Sweep Time: 10 ms - 999s
Resolution: Max. 0.01s
Error: 0.1 ms

Internal Gate
Non-phase-coherent signal keying
Carrier Frequency: 0.1 mHz - 20 MHz (depending on waveform)
Modulation Frequency: 1 kHz
Duty Cycle: 50%

External gate
Modulation Frequency: 0 - 500 kHz; min. on/off time 2 µs

10 MHz Output (PM 5192S only)
Protection: Short-circuit proof, max. external voltage 10V
Frequency: 10 MHz (squarewave)
Level: Typ. 2 dBm >0 dBM
Impedance: 500Ω

External Reference Input (PM 5192S only)
Maximum Voltage: ±5V
Waveform: sine or square
Frequency: $\frac{10\ \text{MHz}}{N}$ N= 1,2,3,...10 for synchronization purposes
Lock-In Time: <2s
Lock-In Range: ±0.1% - a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency
Level: 0 - 20 dBM
Impedance: 50Ω

IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics
Interface Functions: AH1, L4, RL1, SR1, SH1, T6
Listener Address: Decimal programmable via keyboard, indicated by LED display
Address Range: 0 - 30
Service Request: Error and single sweep end message
Remote Lock-Out: Go-to local front panel key
Device Identification and learn modes provided as standard

General Specifications

Non-Volatile Memory: 1 memory location for current setting, 9 memory locations for programmable setting

Rear Connectors: Modulation output BNC; Sweep output BNC; Pen-lift output BNC; Clock output BNC; Modulation input BNC; Clock input BNC; IEEE-488 bus connector; Line connector

Operating Conditions

Reference Temp.: +23°C ±1°C
Operating Temp.: +5°C...+40°C
Storage Temp.: -20°C...+70°C

Power Requirements

Line Voltage: 100, 120, 220, 240V, tolerance ±10%
Line Frequency: 50 - 60 Hz, tolerance ±5%
Power Consumption: 100W
Size: 105 mm H x 440 mm W x 430 mm L. (4.1 in H x 17.3 in W x 16.9 in L)
Rack mounting facility standard (2 units high)
Weight: 10.5 kg (23 lb)
Included with instrument: Operating manual, power cord, rackmount brackets, programming card.

Ordering Information

Model

Model	January 1989 prices
PM 5192M Programmable Synthesizer/Function Generator	$4000
PM 5192SM Programmable Synthesizer/Function Generator with 10 MHz Reference Input	4295

Option

Rear Panel Output	Consult factory

Accessories (Also see page 485)

PM 9581/01 50Ω Feed-Through Termination 3W	65
PM 9585/01 50Ω Feed-Through Termination 1W	30
System 21 Modular GPIB Switching System	See page 380
PM 2122/01 50Ω Coaxial Switch	680
PM 2230 Series Instrument Driver Software	575
PM 2240/001 TestTeam Software	600
PM 2295/05 IEEE Cable 0.5m	150
PM 2295/10 IEEE Cable 1m	155
PM 2295/20 IEEE Cable 2m	170
PM 2296/50 IEEE-488 to IEC-625 Adapter	70
PM 2296/60 IEC-625 to IEEE-488 Adapter	80
PM 9051 BNC to 4 mm Banana Adapter	9

Service & Support

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5191

GPIB IEEE-488

PM 5191

PM 5191 2 MHz Synthesizer/Function Generator

- Five standard waveforms: sine, square, triangle and pos./neg. sawtooth
- Crystal-controlled precision and stability covering 0.1 mHz to 2.147 MHz
- Maximum 30V peak-to-peak output and TTL output
- Completely independent AC and DC settings within the ±15V window
- Full 8-digit resolution with clear LED read-out
- Remote control of all programmable functions via GPIB/IEEE-488 interface
- Internal and external AM modulation

The PM 5191 is a precision frequency source with the assurance of long term stability and reproducibility. A crystal oscillator serves as a reference for the generated frequencies, ensuring the PM 5191 will always continue to provide the selected frequency to a very high standard of accuracy. Distortion is typically a low 0.35% from 1 Hz to 200 kHz. The PM 5191 also offers excellent phase noise of -80 dBc/Hz. Setting error is negligible at $\leq 1 \times 10^{-6}$ and the low aging figure of <1 ppm/year makes the PM 5191's accuracy a true reference standard for applications in R & D, production line testing and quality control, and many other fields of engineering. The PM 5191's frequency range extends from 0.1 mHz to 2.147 MHz (actual range depends on selected waveform). Output voltages are programmable up to 30V pp and can be expressed in Vpp, Vrms or dBm.

Frequency resolution is a full 8 digits, with a maximum resolution of 0.1 mHz allowing full advantage to be taken of PM 5191's very high precision, useful in the identification and measurement of phenomena occuring at precisely defined frequencies.

A choice of five different waveforms covers almost all standard function requirements, with sine, square wave, triangle and sawtooth (positive and negative going). The PM 5191's outstanding capabilities and precision are combined with an economic cost, making this instrument an attractive, general purpose tool for a very wide range of different applications.

Auto-Store

All parameters like frequency, amplitude and DC offset are easily and quickly entered using the front-panel keyboard. Also the current setting is stored in non-volatile memory, and can be used again after switching on the instrument.

GPIB/IEEE-488 Compatibility

The PM 5191 has full GPIB/IEEE-488*/IEC-625 bus compatibility. All functions are remotely selectable via the bus, while settings and status data can be transmitted to a remote controller and recalled whenever required.

In this system mode, large numbers of automatic measurements can be made continuously and with complete reproducibility, for excellence in quality control applications. IEEE-488 addresses are set via the numeric keyboard, and can be displayed on the 3-digit LED display.

Waveform Selection

The waveform keyboard area allows selection of PM 5191's 5 standard waveforms: sine, square wave, triangle and sawtooth (positive and negative going).

All buttons have an LED indicator to show at a glance which function is selected, as well as to provide a warning of functions for which entries are incomplete.

Waveform Output Levels

Key symbol	Waveform	Max. frequency	Output Vpp (open loop)
∿	Sine	2.147 MHz	0...30
⎍	Square	2.147 MHz	0...30
∧∨	Triangle	200 kHz	0...30
⟋	Positive sawtooth	20 kHz	0...15
⟍	Negative sawtooth	20 kHz	0...15

Precise Frequency Programming

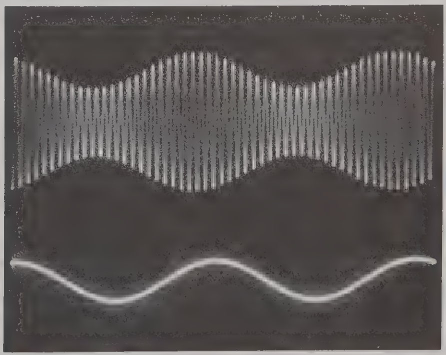
A frequency keypad area allows precise programming of frequency-related settings, choice of dimension (Hz/kHz) and frequency programmable widths for discrete frequency steps. User defined frequency steps can be repeated manually in either direction using the step + or - buttons. Frequency values are programmed via the numeric keyboard, using the ENTER button. The RUB-OUT key on the numeric keypad allows values to be corrected before entry.

Modulation Modes

The PM 5191 has various modulation modes such as AM, FM, burst etc., including AM internal and AM external.

In AM external mode the carrier can be modulated with a frequency between DC and 200 kHz. This DC coupled modulation input allows modulation of the carrier not only with a sinewave but also with a square wave, triangle or superposed sine. With a superposed sinewave (DC = -1.4V) you can generate Amplitude Modulation with suppressed carrier.

The carrier can also be modulated with an external square wave, giving pulse modulation. On-off amplitude ratio is adjusted using the external square wave.



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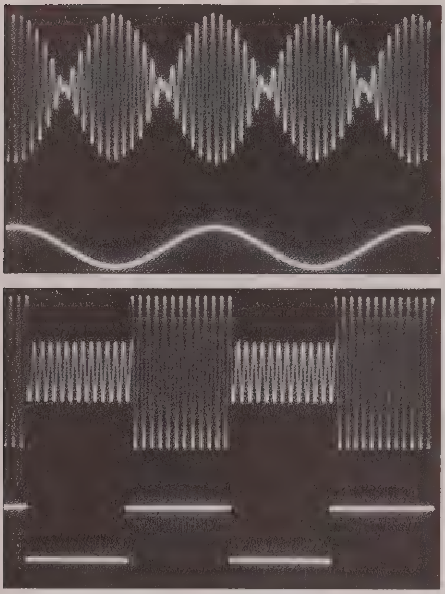
*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog



Output Level Setting

Selection of output levels in Vpp, Vrms or dBm is by means of the keypad, and the selected output voltage is shown on the 3-digit LED display. The step functions (Δ level) allow quick output-level changes in presettable steps. The nominal maximum outputs are waveform-dependent (see table).

Signal outputs, including TTL output, are short-circuit-proof and located on the front panel.

Specially developed circuitry prevents any interaction between AC and DC settings within a ±30V window. These settings may therefore be independently programmed. A warning is given by a flashing key LED if any combined AC and DC setting exceeds the ±30V window.

IEEE-488 Address Setting

Setting of an IEEE-488 system address can be done locally, via the front panel. With PM 5191, all that is necessary is to activate the 'address' key. The current address is then displayed, and a new address can be programmed if required.

Learn and Identification Modes

Learn and identification modes facilitate programming in system environments. In Learn mode, instruction strings for front panel settings can be up-loaded to a controller for later recall.

In identification mode, PM 5191 responds to controller identification requests with its type number and software version. Rack mounting hardware is supplied, increasing versatility in system environments.

Rear Panel Connection Facilities

A number of additional connection facilities are provided on the rear panel of PM 5191:

Inputs:

Ext. clock: PM 5191SM can lock onto external reference signals (10 MHz) applied to the BNC connector. The PM 5191M can lock onto external reference signal from other PM 5191/2/3 generators (8.6 MHz)

Modulation: External frequencies can modulate the carrier (AM).

Outputs:

Int. clock: The reference frequency of (10 MHz or 8.6 MHz) is available at the int. clock connector. This frequency can be used for synchronization purposes, for example with other generators PM 5193 and/or PM 5192.

Modulation: The signal output from PM 5191's internal modulation frequency source is available at this socket for triggering purposes.

IEEE-488 connector: For direct connection of PM 5191 into IEEE-488 bus-oriented measuring systems. The shielded IEEE-488 connector provides optimal security against disturbance of IEEE data.

Specifications

Technical Specifications

Frequency Characteristics

Nominal Range: 0.1 mHz - 2 MHz
Operational Range: Sinewave 2.147 MHz;
Squarewave 2.147 MHz;
Triangle 200 kHz;
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz
Setting: Local via front-panel keyboard.
Remote via IEEE bus interface +/- stepping function with programmable step width
Resolution: 8 digits; <0.1 mHz
Display: 8-digit LED display, Hz/kHz dimension LEDs
Setting Error: $<1 \times 10^{-6}$
Temperature Coefficient: <0.2 p.p.m./K
Aging: <1 p.p.m. per year
Drift: <0.3 p.p.m. in 7h
Phase Jitter RMS: <3 mRAD
Phase Noise: < - 80 dBc/Hz (1 kHz from carrier)

Output Characteristics

Main Output
Connector: BNC socket on front or rear panel
Impedance: $Z_o = 50\Omega$
Load Capability: Short-circuit proof
Max. External Voltage: ±15 Vpp (<3 min.)

AC Voltage
Independent of DC settings within ±15V window
Ranges: I 3.1 - 30 Vpp;
II 0.31 - 3.00V;
III 0 - 0.300V
Resolutions Ranges: I 0.1V;
Range II 0.01V;
Range III 0.001V
Setting: Remote or local +/- stepping
Programmable step width
Basic Setting Error: ±2.5% (1 Hz - 200 kHz) (0.31 - 3.00v)

DC Voltage
Independent of AC setting within ±15V window
Range: +/- 10V open-circuit voltage
Resolution: 0.1V
Error: ±2% of setting ±40 mV
Setting: Remote or local; +/- stepping function.
Programmable step width

TTL Output
Connector: BNC socket on front panel
Fan-Out: <5 TTL inputs
Level: 0/5V

Waveforms

Standard Functions: Sinewave, squarewave, triangle, sawtooth (positive- and negative- going ramps)
Selection: Local via front panel keyboard. Remote via IEEE bus interface
Indication: Key LEDs

Sinewave
Frequency Range: 0.1 mHz...2.147 MHz
Output Range: 0...30 Vpp
Distortion
THD: <0.35% (1 Hz< f <200 kHz, open circuit voltage <10 mVpp)
Harmonics: <-35 dBc (200 kHz< f <2.147 MHz, open circuit voltage ≥10 mVpp)
Spurious: <-40 dBc (0.1 mHz< f <2.147 MHz, open circuit voltage <31 mVpp, distance from carrier <15 kHz)

Squarewave
Frequency Range: 0.1 mHz - 2.147 MHz
Transition Times: <35 ns
Duty Cycle: 50%
Output Range: 0-30 pp
Abberration: <2% ±3 mV range II;
<2% ±20 mV range I

Triangle
Frequency Range: 0.1 mHz - 200 kHz
Output Range: 0 - 30 Vpp
Temperature Coefficient: <0.1%/K
Linearity: <99%

Sawtooth (pos/neg ramps)
Frequency Range: 0.1 mHz - 20 kHz
Output Range: 0 - 15 Vpp
Temperature Coefficient: <0.1%/K
Flyback Time: <1 µs
Linearity: <99%

Modulation

Internal AM
Carrier Frequency: 0.1 mHz - 2 MHz
Modulation Frequency: 1 kHz
Modulation Depth: (30 ±2)%
Modulation Distortion: <0.6% (sinewave modulation)

Modulation Output: 0.3 Veff ±3%

External AM

Modulation Frequency: 0 - 200 kHz

Modulation Distortion: <1.5% (depth <98%) <0.7% (depth <50%)

10 MHz Output (PM 5191S only)

Protection: Short-circuit proof, max. external voltage 10V

Frequency: 10 MHz (squarewave)

Level: Typ. 2 dBm >0 dBM

Impedance: 50Ω

External Reference Input (PM 5191S only)

Maximum Voltage: ±5V

Waveform: sine or square

Frequency: $\frac{10\ \text{MHz}}{N}$ N + 1,2,3...10 for synchronization purposes

Lock-In Time: <2s

Lock-In Range: ±0.1% - a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency

Level: 0 - 20 dBM

Impedance: 50Ω

IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics

Interface Functions: AH1, L4, RL1, SR1, SH1, T6

Listener Address: Decimal programmable via keyboard, indicated by LED display

Address Range: 0 - 30

Service Request: Error message

Remote Lock-Out: Go-to local front panel key

Device Identification and learn modes provided as standard

General Specifications

Miscellaneous

Non-Volatile Memory: 1 memory location for current setting

Rear Connectors: Modulation output BNC; Clock output BNC; Modulation input BNC; Clock input BNC; IEEE bus connector; Mains connector

Operating Conditions

Reference Temp.: 23°C ±1°C

Operating Temp.: 5°C...40°C

Storage Temp.: -20°C...+70°C

Power Requirements

Line Voltage: 100, 120, 220, 240V, tolerance ±10%

Line Frequency: 50 - 60 Hz, tolerance ±5%

Power Consumption: 100W

Size: 105 mm H x 440 mm W x 430 mm L. (4.1 in H x 17.3 in W x 16.9 in L)

Rack mounting facility standard (2 units high)

Weight: 10 kg (22 lb)

Included: Operator's manual, line cord, rackmounting ears.

Ordering Information

Model

January 1989 prices

PM 5191M Programmable Synthesizer /function generator	$3395
PM 5191SM Programmable Synthesizer/ function generator with 10 MHz reference input	3695

Option

Rear Panel Output	Consult Factory

Accessories (Also see page 485)

PM 9581/01 50Ω feed-through Termination 3W	65
PM 9585/01 50Ω feed-through Termination 1W	30
System 21 Modular GPIB Switching System	See page 380
PM 2122/01 50Ω Coaxial Switch	$680
PM 2230 Series Instrument Drivers Software	575
PM 2240/001 TestTeam Software	600
PM 2295/05 IEEE Cable 0.5m	150
PM 2295/10 IEEE Cable 1m	155
PM 2295/20 IEEE Cable 2m	170
PM 2296/50 Bus Adapter, GPIB/IEEE to IEC	70
PM 2296/60 Bus Adapter IEC to GPIB/IEEE	80
PM 9051 BNC to 4 mm Banana Adapter	9

Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5190X

GPIB IEEE-488

PM 5190X

PM 5190X 2 MHz Synthesized Function Generator

- Sine, triangle, square waveforms
- 0.001 Hz...2.147 MHz frequency range
- Max 20 Vp-p output and separate TTL output
- Extremely accurate frequency setting to within ±1 x 10^{-6}
- External AM facility
- Very high short- and long-term stability
- Fast feather-touch parameter selection

This microprocessor-based synthesizer includes many unique features that lift it into a special class of medium-priced signal sources for most professional applications, including instrument calibration. Typical design criteria include ±1 x 10^{-6} frequency setting error and an ageing characteristic of <1.5 x 10^{-6}/year, which clearly underwrites the inherently high accuracy and stability of this instrument.

It will thus be of interest to design or research laboratories seeking such a highly accurate, stable signal source in the range 0.001 Hz to 2.147 MHz for both routine bench use and inclusion in automatic test systems. Its high-grade, virtually zero-error performance, plus simplicity and speed of operation make it equally attractive for use in advanced educational programs.

The output frequency of the crystal controlled oscillator is shown on a bright 6-digit LED display together with the AC (2 digits) and DC (2 digits) outputs. DC polarity is also displayed.

In addition, the preselected waveforms and external amplitude modulation characteristics are indicated on this panel.

The user has a choice of sine, square and triangle waveform outputs which are available from a 50Ω front panel socket (BNC connector).

In addition, there is an adjacent TTL socket. External amplitude modulation signals, from 0...<90% modulation depth can be connected via a rear input socket.

A very clear, simply designed front panel makes operation extremely easy. Fast selection of the desired parameters is assured by 'feather-touch' input push buttons.

Maximum AC output, for all waveforms is 19.9 Vpp. A DC offset voltage of up to 9.9V max., is available for setting this output to the desired DC level, up to 19.9V total amplitude. Voltage levels can be set in minimum increments of 1 mV.

All functions are fully remotely controllable via the built-in IEC-bus interface, enabling the unit to be used within an automatic testing system, if desired, (no modifications or extra accessories are needed). The PM 2296/60 adapter allows the PM 5190X to also be used in GPIB/IEEE-488* systems. This facility is further enhanced by the high switching speeds resulting from a direct digital signal synthesis technique.

All these comprehensive facilities are contained in a very compact, portable package.

Typical applications in an automated system include, for example:

- Accurate testing of audio filters when checking bandpass curves.
- As a standard, when checking servo motor speed control systems or for audio/video tape stress testing; etc.

Also, when employed as a signal source for calibrating instruments (e.g. frequency meters) its highly accurate and stable output signal may be used.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 1 mHz...2.147 MHz
Measuring Range: 1 mHz...2.147 MHz for sine and square wave;
1 mHz...<100 kHz for triangle wave

Setting
Local: Via front panel keyboard
Remote: Via IEC bus interface
Display: 6-digit 7-segment LED display;
6 decimal points;
2 LEDs for dimension Hz, kHz
Setting Error: ±1 x 10^{-6} at 23°C
Temperature Coefficient: <1 x 10^{-6}/K
Ageing: <1.5 x 10^{-6} per year

Waveforms

Sine wave
Square wave
Triangle wave
All time-symmetrical
All with or without DC offset
DC voltage without AC

Selection
Local: Via front panel keyboard
Remote: Via IEC bus interface
Indication: LEDs for the selected waveforms

Sine Wave

Total Harmonic Distortion: <0.4% (1 mHz... 50 kHz);
<1.5% (50 kHz...2.147 MHz)
Non-Harmonic Components at Max. Amplitude: <-46 dB
Phase Noise: <-50 dB within 30 kHz bands, centered to the output frequency; (frequencies <50 kHz)

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 5190X

Square Wave

Rise Time, Fall Time: <50 ns
Duty Cycle: 50%
Tilt: <3% (f <100 kHz)
Overshoot: <3%
Duty Cycle: 50%
Tolerance: <0.5% (f + 1 kHz)

Triangle Wave

Frequency Range: 1 mHz...<100 kHz
Linearity: <99% for frequencies <10 kHz

Modulation

Mode: Amplitude modulation, external
Indication: LED
Carrier: Sinusoidal and triangular waveform frequency <10 Hz
Modulation Frequency: DC...20 kHz
Modulation Coefficient: 0.1V per 10% AM
Modulation Depth: 0...90%
Connector: BNC socket AM EXT (rear side)
Input Impedance: 20 kΩ
Max. External Voltage: ±30V
Reference Potential: External contact of BNC socket

Output Characteristics

Connector: BNC socket (front side)
Impedance: 50Ω ±2%
Short-Circuit Proof: Yes
Max. External Voltage: ±15V
Reference Potential: External contact of BNC socket

AC Voltage

Range: 19.9 VACp-p open circuit
Sub-Ranges:
I .000...0.199 VAC
II 0.00...1.99 VAC
III 00.0...19.9 VAC

Setting
Local: Via front panel keyboard
Remote: Via IEC bus interface
Display: 2 digit, 7-segment LED
Setting Error: 3% for settings 2.0V <AC <19.9V for frequencies <100 kHz
Temperature Coefficient: 0.1%/K

DC Offset Voltage

Range: 0...9.9 VDC
Sub-Ranges:
I .000...0.099 VDC
II 0.00...0.99 VDC
III 00.0...09.9 VDC
Sub-Range Selection: Determined by subrange setting
Mimimum Increments:
1 mV in sub-range I
10 mV in sub-range II
100 mV in sub-range III
Polarity: Positive or negative selectable via keyboard

Setting
Local: Via front panel keyboard
Remote: Via IEC bus interface
Display: 2-digit, 7-segment LED, decimal point, position determined by AC decimal point setting
Setting Error: 4% (10%...100% of each subrange)
Temperature Coefficient: <0.1%/K
(10%... 100% of each subrange)
Max. DC Voltage Setting: Depending on AC voltage setting: DC indication 1100 - (AC indication)/2; decimal points ignored

TTL Output

Connector: BNC socket TTL OUT
Duty Cycle: 50%
Fan Out: ≥10
Level: Standard TTL-level

Out-of-Range Indication

Display flashes if,
- frequency setting <2147 kHz
- frequency setting >100 kHz for triangle
- frequency resolution <1 mHz
- DC voltage exceeds in max AC voltage setting

Remote Control

Conformity: IEC-625: interface system of programmable measuring apparatus
Interface: Built-in IEC bus interface
Remote State Indication: Front panel LED
Programmable Parameters:
- frequency
- AC voltage
- DC voltage
- wave form

Response Time:
- 4 ms for waveform
- 10 ms for AC voltage
- 7 ms for frequency
- 12 ms for DC voltage

IEEE/IEC Interface Data
An IEC-625 interface is supplied, being built into the instrument, with rear access
Connector: 25-pole IEC standard connector
Interface Functions:

AH1	Acceptor handshake
L2	No additional functions possible
RL2	Remote/local total capability

Code: ISO 7-bit code
Connector: 25-pole standard interface connector (rear side)
Max. External Voltage: -0.5...+5.5V, standard TTL level
Reference Potential: Measuring earth
Connector Housing: Connected to protective conductor

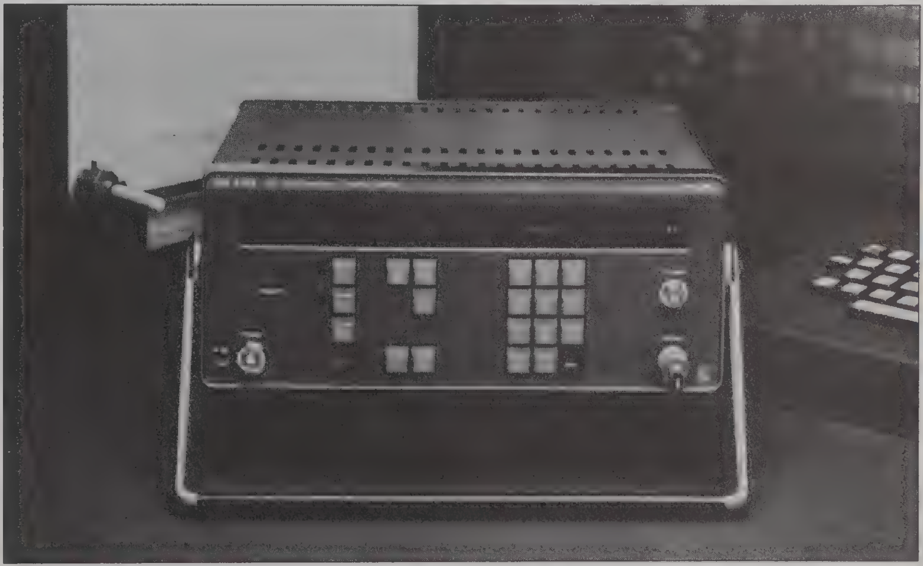
General Specifications

Power Requirements

Voltage: 110, 120, 220, 238V ±10%
Power Consumption: 47W
Frequency: 50/60 Hz

Operating Conditions

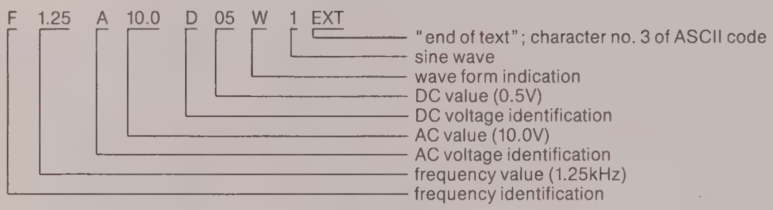
Reference Value: +23°C ±1°C
Nominal Range: +5°C...+40°C
Limits for Storage and Transportation:
-40°C...+70°C
Size: 310 mm W x 140 mm H x 365 mm L (12.5 in W x 5.5 in H x 14.5 in L)
Weight: 6 kg (13.2 lb)
Included with instrument: Instruction manual, attached line cord



Automatic measuring and plotting of frequency response is made easier using the PM 5190X.

PM 5190X

PROGRAMMING EXAMPLE


F 1.25 A 10.0 D 05 W 1 EXT
"end of text"; character no. 3 of ASCII code
sine wave
wave form indication
DC value (0.5V)
DC voltage identification
AC value (10.0V)
AC voltage identification
frequency value (1.25kHz)
frequency identification

Ordering Information

Model

PM 5190XM 2 MHz Synthesizer	$2600

Accessories (Also see page 485)

PM 9075 Coaxial Cable BNC BNC	11
PM 9560 19-in Rackmount Adapter	130
PM 2122/01 50Ω Coaxial Switch	680
PM 2240/001 TestTeam Software	925
PM 2296/60 IEC-625/IEEE-488 Adapter	80
System 21 Modular GPIB Switching System	See pg 380

Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491

PM 5134

PM 5134

PM 5134 20 MHz Function/Sweep Generator

- Sine, square, triangle, pulse
- 0.001 Hz...20 MHz frequency range in 7 sub-ranges
- 20 Vp-p output and separate TTL output
- Normal or high accuracy crystal controlled operation
- Internal or external sweep and AM/FM modulation facilities
- Burst and single-cycle with variable start phase
- Stepped and variable attenuation over 60 dB range

The PM 5134 is an easy-to-use, yet extremely sophisticated function generator embodying an unusually wide range of facilities in a single instrument.

It will produce sine, square and triangle waveforms as well as positive and negative pulses and DC. The duty cycle is variable between 10% and 90%.

The wide, 1 mHz to 20 MHz frequency range is divided into 10 sub-ranges, which are selected by means of a rotary switch with an overriding coarse/fine adjustment. This fine adjustment, combined with the 3-digit LED display, gives an immediate, highly accurate readout of the selected frequency. Setting-up procedures are thus very much simplified compared with the traditional dial setting and any human errors (e.g. parallax) are eliminated.

In addition, the 3-digit display can be used to monitor the open-circuit output voltage by depressing a push-button. Also, when used in the sweep mode, the start, stop and run frequencies are indicated by separate LEDs. Moreover, an error warning lamp automatically indicates any incompatible set-up conditions.

The high, nominal accuracy (see technical specification) of ±2% ±1 digit, can be further improved to ±5 x 10^{-6} by operating the instrument in the crystal-controlled mode. This facility is useful, for example, for identical repetitive measurements requiring high accuracy, or for narrow band filter tests. The crystal AM mode offers a stable carrier wave. One particular application is when using a 10.7 MHz carrier frequency to check that the discriminator section of a radio receiver is suppressing the AM waveform.

The continuously variable 20 Vp-p max. output (10 Vp-p pulses) is available at the front-panel mounted socket; there is a push-button choice of 600Ω or 50Ω output impedance. Output attenuation is selectable in any combination of 3-6-10-20 dB push-buttons with an overriding continuous 20 dB control. Sweep facilities include single and continuous operation. The single sweep can be triggered either manually, or electronically from an external source. The sweep period is continuously adjustable between 5 ms and 100s. The START and STOP frequencies are non-interactive and can be set independently of each other. A HOLD facility allows a sweep to be stopped at any desired frequency useful for checking phenomena occurring during a sweep by means of a push-button. An interrupted sweep is continued by simply releasing the HOLD button. If required a sweep can be reset to the start frequency using the RESET push-button.

The generator offers an internally or externally controlled burst or single-cycle signal. The start/stop phase is continuously adjustable between -90° and +90°.

The internal AM is adjustable between 0 and 100% modulation depth. The modulation frequency can be set over a wide range from 10 mHz to 20 kHz. The AM facility can be used with crystal control, if desired. External AM inputs in the range from DC to 20 kHz can be applied via a rear-mounted BNC-socket.

The internal FM can be adjusted, continuously, between zero and ±10% frequency deviation.

Other input/output facilities available on the rear panel include a TTL output and pen-lift control.

The well-considered design of the PM 5134 has resulted in a clean, simple front panel layout which allows the operator to become familiar with all control functions very quickly. Its overall versatility makes it suitable for a very wide range of applications within research design or educational organizations. The instrument occupies minimal bench space and is short-circuit proof.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 1 mHz...20 MHz

Display: 3 digits; 7-segment LED; 4-dimension LEDs mHz, Hz, kHz, MHz.

Setting Error: ±2% ±1 digit (1 mHz...2 MHz) ±5% ±1 digit (2 MHz...20 MHz)

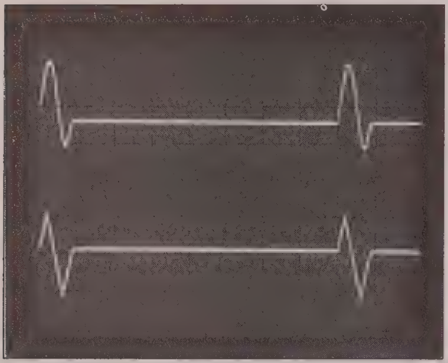
Temperature Coefficient: <1.0 x 10^{-3}/K (20 MHz range excluded)

Short Term Drift: (<15 min)
<1 x 10^{-3} (1 mHz...2 MHz)
<4 x 10^{-3} (2 MHz...20 MHz)

Long Term Drift: (<7h); <3 x 10^{-3}

Duty Cycle: 50% fixed
<10%...>90% continuously variable (20 MHz range excluded)

PM 5134

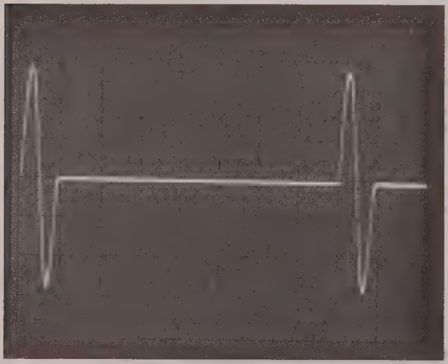


Repetitive single sine wave and triangle shown with different start phase

Waveforms: Sine wave, square wave, triangular wave, positive pulse, negative pulse (with or without DC offset), DC voltage without AC

Output

AC Voltage
Max. Open Circuit Voltage: 20 Vp-p (10 Vp-p for pulse)
Indication Open Circuit Output Voltage: Alt. mode frequency display
Attenuation: 3, 6, 10, 20 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable



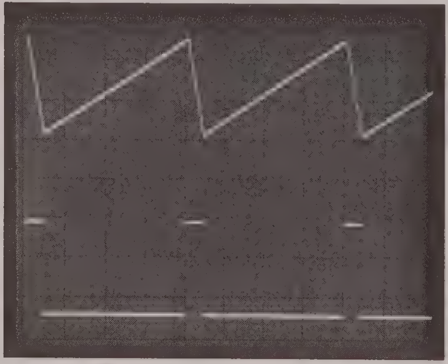
Repetitive single sine wave signal

Impedance: 50Ω or 600Ω selectable
Short-Circuit Proof: Yes
DC Voltage
Offset Voltage: -5V...+5V (open circuit)
Sine Wave
Total Harmonic Distortion: <0.5% (1 Hz...200 kHz); <3% (1 mHz...2 MHz)
All harmonics more than 26 dB below fundamental (1 MHz...20 MHz)
Frequency Response of Amplitude: <0.1 dB (0.1 Hz...200 kHz);
<0.5 dB (1 mHz...2 MHz);
<1.5 dB (1 MHz...20 MHz, for max. amplitude)

Triangle Wave
Linearity: <99% (<100 kHz)
Square Wave
Rise and Fall Time:<18ns
Overshoot and Ringing: <3%
Positive/Negative Pulses
See Square Wave
TTL
Duty Cycle: As main output
Fan Out: <5
Pen Lift
Internal Modulation

Sweep Facilities

Internal Sweep
Characteristics: Linear
Max. Sweep Range: 2 decades
Mode: Single or continuous
Indication: 3½ digits, 7-segment LED, 3 LEDs STOP, RUN and START
Period Time: 5 ms...100s Continuously adjustable in 4 sub-ranges
Control Functions: HOLD, RESET, TRIG (manually) and electronic triggering
Frequency Control Voltage at Modulation Output: 0...5V (f start...f stop)
External Sweep/FM
Input: SWEEP/FM
Characteristics: Linear
Voltage/Frequency Characteristic: 1V/0.2 max. frequency
Max. Sweep Range: >2½ decades for subranges above 2 Hz
Input Resistance: 5kΩ
Max. Sweep Rate:>200 Hz (1½ decades range)
Sweep Voltage: Sawtooth, duty cycle 90%



Variable duty cycle shown in triangular and square wave signals

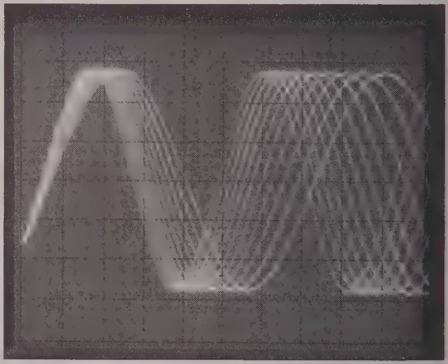
Burst Facilities

Internal Burst
Continuous Operation
On/off Ratio: Approx. 1:1 (last cycle ends at START-PHASE level)
Repetition Time: 0.05 ms...100s Continuously adjustable in 6 sub-ranges

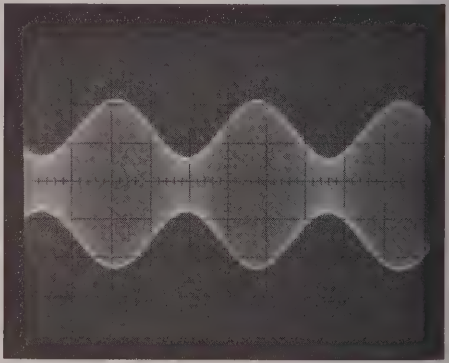
Single Operation
Duration: See Continuous Operation, Repetition time
Triggering: Manually or electronically via TRIG & BURST input
Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable
External Burst
Input: TRIG & BURST
Control Voltage: TTL-level
Start: Low/High-transition
Stop: High/Low-transition.(when output signal reaches START-PHASE)
Max. Control Frequency: 2 MHz
Start Phase: -90°...+90°(-π/2...+π/2), continuously adjustable

Single Facilities

Internal Single Continuous Operation
Repetition Time: 0.05 ms...100s continuously adjustable



Frequency sweep or frequency modulation



Carrier wave with AM modulation

Single Operation
Triggering: Manually or electronically via TRIG & BURST input
Start Phase:-90°...+90° (-π/2...+π/2), continuously adjustable
External Single
Input: TRIG & BURST

Modulation

Internal FM

Modulation Waveform: Sine wave
Deviation: Approx. 0%...10%
Continuously adjustable
Modulation Frequency: 0.01 Hz...20 kHz
Continuously adjustable in 6 sub-ranges
Modulation Voltage: Available at modulation output

External FM

Input: SWEEP/FM

Internal AM

Modulation Waveform: Sine wave
Modulation Depth: 0...<100%
Continuously adjustable
Modulation Frequency: See internal FM
Modulation Voltage: See internal FM

External AM

Input: AM
Modulation Waveform: Arbitrary with spectral components up to 20 kHz
Modulation Depth: 0...<100%
Continuously adjustable

Crystal Mode

Frequency Lock: Freezes the momentary frequency display (frequency setting inhibited)
Accuracy: ±5 x 10^{-6}

Crystal AM Mode

See X-tal mode with additional facilities of internal and external AM

Burst signal

General Specifications

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Power Consumption: 55 W
Frequency: 50/60 Hz

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -40°C...+70°C
Size: (wxhxd) 310 mm W x 140 mm H x 390 mm L (12.2 in W x 5.15 in H x 15.4 in L)
Weight: 6.5 kg (14.3 lb)
Included with instrument: Instruction manual, attached line cord

Ordering Information

Model	January 1989 prices
PM 5134M Function Generator	$2600

Accessories (Also see page 485)	
PM 9075 Coaxial Cable BNC	11
PM 9581/01 50Ω/3W Termination	65
PM 9051 Adapter BNC/4mm	9
PM 9560 19-in Rackmount Adapter	130

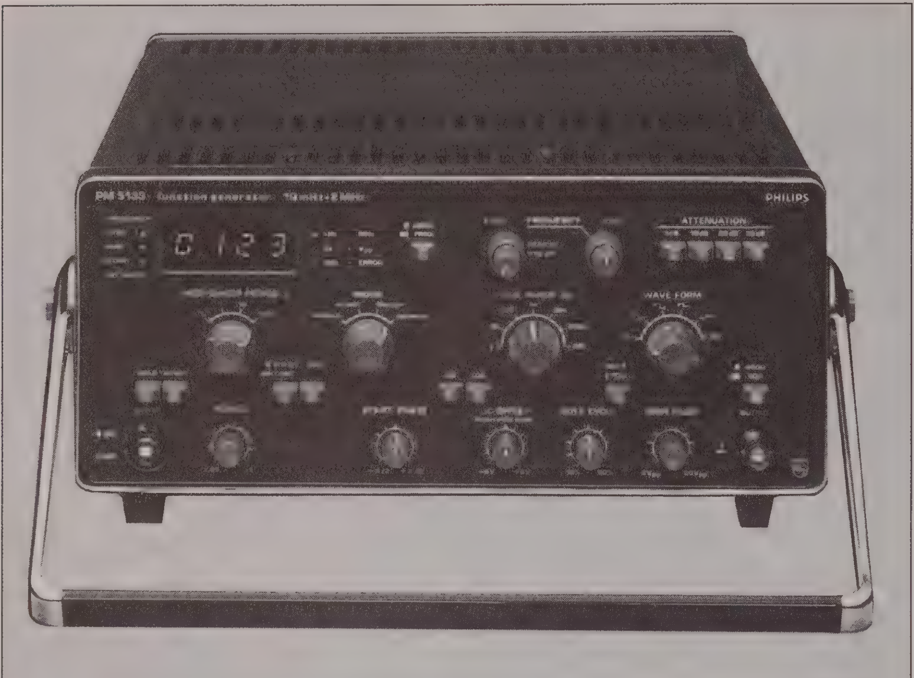
Service & Support

Warranty

One-year product warranty. See Page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5133



PM 5133

PM 5133 2 MHz Function/Sweep Generator

- Sine, square, and triangular waveforms, pos./neg. pulses, DC
- 0.01 Hz...2 MHz frequency range in 7 sub-ranges
- 20 Vp-p output
- Logarithmic or linear sweep with manual and electronic sweep trigger
- Internal or external sweep facility
- Single and burst with variable start phase
- Frequency and open circuit output voltage indicated on 3-digit LED display

The versatile PM 5133 function generator offers both linear and logarithmic sweep facilities in addition to a wide range of other features. Outputs include sine, triangle and square waveforms as well as positive or negative pulses, and DC, The duty cycle is variable between 10% and 90%.

The wide frequency range of 10 MHz to 2 MHz is selected by means of a 7-position rotary switch with an overriding coarse/fine adjustment. A high-precision, electronic system, using a 3-digit LED provides very accurate, clearly readable setting conditions and eliminates those human errors (e.g. parallax) likely to occur with more conventional mechanical dials. The display is also used to monitor the open-circuit output voltage, sweep limit values and incompatible set-up conditions.

The output voltage (20 Vp-p max., except for pulses at 10 Vp-p max.) is available at the front-panel mounted socket; there is a push-button choice of 50Ω or 600Ω output impedance. Output attenuation of more than 80 dB is selectable in any combination of calibrated steps of 3-10-20-30 dB with an overriding 20 dB continuous control. The output voltage level can be checked by simply depressing a push- button, and can be read on the LED display.

Linear or Logarithmic Sub-Ranges

Sweep facilities include single-shot and continuous operation, with the choice of linear or logarithmic mode. Frequency ranges are divided into either seven linear or five logarithmic sub-ranges with continuous coarse and fine adjustment. The logarithmic sweep ranges cover more than four decades, making the instrument extremely useful for sweeping within the audio range.

The single sweep can be triggered either manually, or electronically, from an external source. The sweep period is continuously adjustable between 5 ms and 100s. The START and STOP frequencies are non-interactive and can be set independently of each other. Also, a HOLD facility allows a sweep to be stopped at any desired frequency - useful for checking phenomena which may appear during a sweep - by means of a push-button.

An interrupted sweep is re-started by simply releasing the HOLD button. Again, if required, a sweep can be reset back to the start frequency using the RESET button. When used in the sweep mode, the start, stop and run frequencies are all indicated clearly on separate LEDs.

An error warning LED automatically flashes in the event of any incompatible setting made by the operator.

The generator also offers an internally or externally controlled burst, or single waveform signal, having a continuously adjustable start/stop phase, -90° and +90°.

Other input/output facilities available at the rear panel include a TTL output and pen-lift control, internal modulation voltage and frequency control voltage.

In addition, the PM 5133S version, described on page 282, adds specific features for audio test.

The PM 5133 is designed for maximum electrical and mechanical protection. Careful attention has been given to ergonomic considerations, making the instrument easy to use. Its overall versatility makes it suitable for use within a wide range of applications such as research, design, education and manufacturing. It occupies minimal bench space and is short-circuit proof.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 10 mHz...2 MHz
Display: 3 digits, 7-segment LED, 4 dimension LEDs mHz, Hz, kHz, MHz.
Setting Error:
±2% ±1 digit (10 mHz...200 kHz)
±3% ±1 digit (200 kHz...2 MHz)
Temperature Coefficient:
<1.0 x 10^{-3}/K (linear mode)
<2.5 x 10^{-3}/K (log mode)
Short Term Drift: (<15 min)
<1 x 10^{-3} (10 mHz...20 kHz)
<3 x 10^{-3} (20 kHz...2 MHz)
Long Term Drift: (<7h)
<3 x 10^{-4}

PM 5133

Duty Cycle: 50% fixed
<10%...<90% continuously variable

Waveforms

Sine wave
Square wave
Triangular wave
Positive pulse
Negative pulse
} with or without DC offset
DC voltage without AC

Output

AC Voltage
Max. Open Circuit Voltage: 20 Vp-p (10 Vp-p for pulse)
Indication (EMF): Alt. mode frequency display
Attenuation: 3, 10, 20, 30 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable
Impedance: 50Ω or 600Ω selectable
Short-Circuit Proof: Yes

DC Voltage
Offset Voltage: 0...±5V (open circuit)

Sine Wave
Total Harmonic Distortion:
<0.5% (10 mHz...200 kHz)
<2% (200 kHz...2 MHz)
Frequency Response of Amplitude:
<0.1 dB (10 mHz...20 kHz)
<0.3 dB (20 kHz...1 MHz)
<1.0 dB (1 MHz...2 MHz) (Max. amplitude)

Triangle Wave
Linearity: <99% (10 mHz...100 kHz)

Square Wave
Rise and Fall Time: <60 ns
Overshoot and Ringing: <2% (max. amplitude into 50Ω)

Positive/Negative Pulses
See SQUARE WAVE

TTL
Duty Cycle: As main output
Fan Out: <20

Pen Lift

Internal Modulation

Frequency Control Voltage

Sweep Facilities

Internal Sweep
Characteristics: Linear or logarithmic
Max. Sweep Range: 2 decades (linear mode) 4 decades (log mode)
Mode: Single or continuous
Indication: 3 digits, 7-segment LED, 3 LEDS STOP, RUN and START
Period Time: 5 ms...100s
Continuously adjustable in 4 sub-ranges
Control Functions: HOLD, RESET, TRIG (manually and electronically)
Internal Modulation Output:
0V start frequency;
5V stop frequency
Frequency Control Voltage Output: 0...5V (depending on start- and stop-frequency)
External Sweep/FM
Input: SWEEP/FM
Characteristic: Linear or logarithmic
Linear Characteristic: 1V/0.2 max. freq.
Logarithmic Characteristic: 1V/freq. decade
Max. Sweep Range:
<2 decades (linear mode)
<4 decades (log mode)
Input Resistance: 5 kΩ
Max. Sweep Rate: <4 kHz (1 decade range)
Sweep Voltage: Sawtooth, duty cycle 90%

Burst Facilities

Internal Burst
Continuous Operation
On/Off-Ratio: Approx. 1:1 (last cycle ends at START-PHASE level)
Repetition Time: 5 ms...100s
Continuously adjustable in 4 sub-ranges
Single Operation
Repetition Time: See INTERNAL BURST
Triggering: Manually or electronically via TRIG & BURST input
Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable
External Burst
Input: TRIG & BURST
Control Voltage: TTL-level
Start: Low/high-transition
Stop: High/low transition. (when output signal reaches start phase)
Max. Control Frequency: 2 MHz
Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable

Single Facilities

Internal Single
Repetitive Mode: Same as INTERNAL BURST
Single Triggering: Same as INTERNAL BURST
Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable
External Single
Input: TRIG & BURST
ERROR INDICATION

General Specifications

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Power Consumption: 38W
Frequency: 50/60 Hz

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -40°C...+70°C

Size: 310 mm W x 140 mm H x 390 mm L (12.2 in W x 5.5 in H x 15.4 in L)
Weight: 5.8 kg (14.3 lb)

Included with instrument: Instruction manual, attached line cord

Ordering Information

Model

	January 1989 prices
PM 5133M Function Generator	$1950

Accessories (Also see page 485)

PM 9075 Coaxial Cable BNC	11
PM 9581/01 50Ω/3W Termination	65
PM 9051 Adapter BNC/4 mm	9
PM 9560 19-in Rackmount Adapter	130

Service & Support

Warranty
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5133S

PM 5133S

PM 5133S 2 MHz Function/Sweep Generator

- All PM 5133 features plus:
- Specially adapted for Hi-Fi testing according to DIN standard 45 541
- Fixed 50s sweep, 20 Hz...20 kHz selectable
- Sweep started manually or by 1 kHz burst signal
- 26 dB attenuation facility included

The PM 5133S is an enhanced version of the PM 5133, with extra features specifically included to permit the testing of Hi-Fi equipment to DIN standards.

Used in conjunction with an X-Y recorder, it permits the frequency characteristics of, for example, record players, cassette and tape recorders, to be plotted. This instrument has wide-ranging applications in R&D and quality control. It is also ideal for use by audio service workshops — permitting them to show customers whether their equipment is performing according to specification.

The PM 5133S includes all the facilities of the standard PM 5133, plus a single sweep with fixed 50s duration. Start and stop frequencies should be set at respectively 20 Hz and 20 kHz.

The sweep is preceded by a 1 kHz burst lasting 6 seconds when manually triggered. A similar signal fed in via the TRIG and BURST input will automatically start the generator sweep (without burst), as an alternative to manual start.

With this feature it is possible to start a sweep on a record, cassette or tape (provided this is preceded by the burst) synchronously with the sweep of the generator.

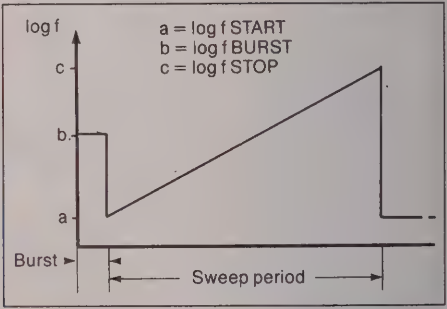
The special sweep is selected by means of the MOD SWEEP PERIOD switch (position 100s) and the PERIOD adjustment (fixed position) with the generator in the logarithmic sweep mode.

Specifications

(Additional to technical specification of PM 5133 for the special sweep).

Output

Attenuation - Fixed: 0, 6, 10, 20, 30 dB, selectabel in any combination
Sweep, Internal: 50s sweep
Mode: Single sweep with fixed period and 1 kHz burst, started by push-button TRIG;
Single sweep with fixed period, electronically started by an external 1 kHz burst applied at input TRIG & BURST
Characteristic: Logarithmic
Start Frequency: 20 Hz set by means of potentiometer START FREQUENCY
Stop Frequency: 20 kHz set by means of potentiometer STOP FREQUENCY
Burst Frequency: 1 kHz (depending on the setting of the start frequency)
Burst Period: 6s
Sweep Period: 50s ±0.2s when:
SWEEP PERIOD in pos. 100 (S);
PERIOD in fixed pos. "S"
Trigger Signal: 1 kHz ±100 Hz
Trigger Sensitivity: 0.5 Vrms
Reset Trigger: By a 1 kHz burst possible after 40s sweep period
a = log f START
b = log f BURST
c = log f STOP
Included with instrument: Instruction manual, attached power cable.



Ordering Information

Model	January 1989 prices
PM 5133SM Function Generator 0.1 Hz - 2 MHz	$2100

Accessories (Also see page 485)

PM 9075 Coaxial Cable BNC	11
PM 9581/01 50Ω/3W Termination	65
PM 9051 Adapter BNC/4 mm	9
PM 9560 19-in Rackmount Adapter	130

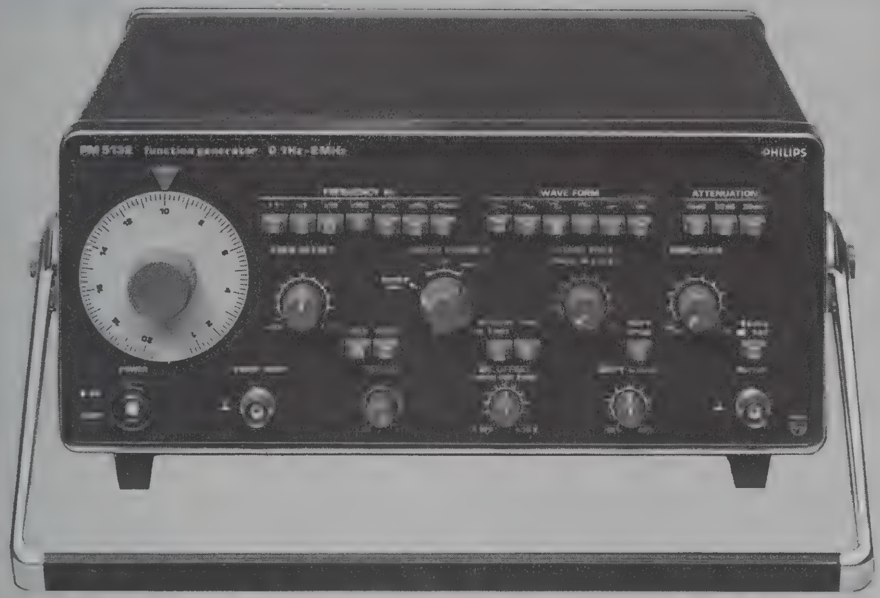
Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5132



PM 5132

PM 5132 2 MHz Function Generator

- Sine, square, triangular waveforms, positive- and negative-going pulses plus DC
- 0.1 Hz...2 MHz in 7 overlapping sub-ranges
- Output: 30 Vp-p (sine, triangle, square); (15 Vp-p for pulses)
- Stepped and variable attenuation over 80 dB range
- Variable DC-offset
- Internal and external sweep facility
- Variable duty cycle

The PM 5132 function generator is a general-purpose instrument that will be very attractive for educational applications as well as for laboratory use. It is an extremely versatile generator which produces sine, triangle and square waveforms plus positive and negative pulses, plus DC. It exhibits a high, 30 Vp-p output for all waveforms and 15 Vp-p for pulses. Output impedance is switchable with a choice of 50Ω or 600Ω.

The duty cycle for all waveforms is variable between 10% and 90% and DC-offset can be selected independently for any waveform. This is adjustable from -10V to +10V.

The frequency range of 0.1 Hz to 2 MHz is adjustable through 7 overlapping subranges and the vernier control allows dial settings of ±2% of the maximum subrange frequency setting.

Sweep facilities are varied and include:

- Choice of linear single or continuous sweep
- Adjustable start frequency in the selected sub-range which is independent of stop frequency
- Maximum linear sweep range of 2 decades
- Sweep period setting between 50 ms and 100s
- Control functions with HOLD or RESET by push-button
- Electronic triggering

A pen-lift output is provided and the instrument is short-circuit proof.

Good ergonomic design makes the operation simple while the instrument occupies minimal bench space.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 0.1 Hz...2 MHz
Indication: Linear dial
Setting Error: ±2%...±0.2% of max subrange frequencies
Vernier Frequency Adjustment: -5%...+5% of frequency setting
Temperature Coefficient: <0.15%/K
Short Term Drift: <0.1%, f <200 kHz (<15 min)
Long Term Drift: <0.25%, f <200 kHz (<7h)
Duty Cycle: 50% fixed
<10%...<90% continuously adjustable

Waveforms

Sine wave
Square wave
Triangular wave
Positive pulse
Negative pulse
DC voltage without AC

} with or without DC-offset

Outputs

AC Voltage
Max. Open Circuit Voltage: 30 Vp-p (15 Vp-p for pulse)
Attenuation: 10, 20, 30 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable
Impedance: 50Ω or 600Ω selectable
Short-circuit proof: Yes

DC Voltage
Offset Voltage: -10...+10V (open circuit)

Sine Wave

Total Harmonic Distortion
<0.5% (0.1 Hz...20 kHz)
<1.0% (20 kHz...200 kHz)
<3.0% (200 kHz...2 MHz)
Frequency Response of Amplitude:
<0.1 dB (0.1 Hz...20 kHz)
<0.3 dB (0.1 Hz...1 MHz)
<1.0 dB (0.1 Hz...2 MHz)
Linearity: <99% (0.1 Hz...100 kHz)

Square Wave

Rise and Fall Time: <75 ns
Overshoot and Ringing: <2%

TTL

Duty Cycle: As main output
Fan Out: <20

PM 5132

Pen Lift

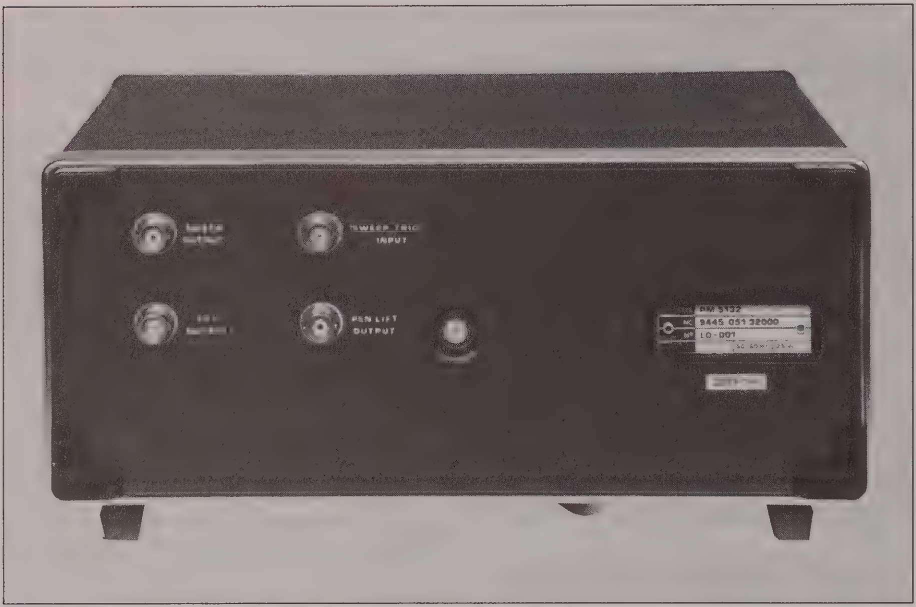
Sweep Output

Internal Sweep

Characteristics: Linear
Max. Sweep Range: 2 decades
Mode: Single or continuous
Period Time: 50 ms...100s
Continuously adjustable in 3 subranges
Control Functions: HOLD, RESET, TRIG (manually and electronically)
Frequency Control Voltage: 0...5V (depending on start- and stop-frequency)

External Sweep

Input: SWEEP TRIG
Characteristic: Linear
Max. Sweep Range: 2 decades
Input Resistance: 47 kΩ
Max. Sweep Frequency: 15 kHz approx.
Sensitivity: 5V for maximum range



Rear view of PM 5132 showing location of sweep, TTL and pen lift outputs and the sweep trigger input.

General Specifications

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Power Consumption: 25W
Frequency: 50...100 Hz

Operating Conditions

Reference Value: +23°C +1°C
Nominal Operating Range: +5°C...+40°C
Limits for Storage and Transportation: -40°C...+70°C
Dimensions: 310 mm W x 140 mm H x 330 mm L (12.6 in W x 5.5 in H x 13 in L)
Weight: 5 kg (11 lb)

Included with instrument: Instruction manual, attached line cord

Ordering Information

Model

January 1989 prices

PM 5132M Function Generator	$1050

Accessories (Also see page 485)

PM 9075 Cable BNC-BNC	11
PM 9560 19-in Rackmount Adapter	130

Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5131

PM 5131

PM 5131 2 MHz Function Generator

- Sine, square, triangular waveforms
- 0.1 Hz...2 MHz frequency range/in 3 logarithmic sub-ranges
- Max. 30 Vp-p output and separate TTL output
- Stepped & variable output attenuation over 80 dB range
- Logarithmical sub-ranges
- Variable DC offset
- Internal & external sweep facility

The PM 5131 function generator is an instrument designed for applications extending from educational to the broad general purpose area. Its many features make it an extremely versatile instrument for a modest price. Among these features are the high, 30 Vp-p output voltage and the facilities for both internal and external sweep. This latter feature covers the audio frequency range in a single shot. The frequency is adjustable in three logarithmical sub-ranges from 0.1 Hz to 2 MHz. The frequency vernier allows the frequency setting to be varied from -20% to +20%. The maximum output voltage is 30 Vp-p (open circuit) on the main output having a 50Ω mpedance. The attenuation can be set over a wide range, either in calibrated steps of 10 dB to a maximum of 60 dB or in combination with the 20 dB continuous attenuator.

A sine, triangle or square wave signal is selected by simply pressing the appropriate push-button. DC voltage can be selected separately without any waveform or whenever used as DC offset can be varied between -10V and +10V.

PM 5131 also provides a 3¹/₃ decade internal sweeping facility with adjustable sweep range and a variable sweep period from 10 to 150 seconds.

This is especially useful when sweeping in the audio range to cover the frequency range of 20 Hz...20 kHz in a single sweep. Added to the versatility of this instrument are an external sweep facility and a TTL output. Good ergonomic design makes operation simple while the instrument occupies minimal bench space.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 0.1 Hz...2 MHz
Indication: Logarithmic dial
Setting Error: ±10%
Vernier Frequency Adjustment: -20...+20% of frequency setting
Temperature Coefficient: <0.5%/K
Short Term Drift: (<15 min) <1.5%
Long Term Drift: (<7h) <3%

Waveforms

Sine wave Square wave Triangular wave DC voltage without AC	with or without DC offset

Output

AC Voltage
Max. Open Circuit Voltage: 30 Vp-p
Attenuation: 10, 20, 30 dB calibrated steps selectable in any conbination plus 20 dB continuously adjustable
Impedance: 50Ω
Short-Circuit Proof: Yes
DC Voltage
Offset Voltage: -10...+10V (open circuit)

Sine Wave

Total Harmonic Distortion:
<0.5% (0.1 Hz...20 kHz)
<3.0% (0.1 Hz...2 MHz)
Frequency Response of Amplitude:
<0.1 dB (0.1 Hz...20 kHz)
<0.3 dB (1 kHz...1 MHz)
<1.0 dB (1 kHz...2 MHz)

Triangle Wave

Linearity: <99%

Square Wave

Rise and Fall Time: <75 ns
Overshoot and Ringing: <2%

TTL

Duty Cycle: 50%
Fan Out: <20

Internal Sweep

Characteristics: Logarithmic
Max. Sweep Range: 3¹/₃ decade
Mode: Single
Period Time: <10...150s
Continuously adjustable
Frequency Analog Voltage: 1V/frequency decade

PM 5131

External Sweep

Input: SWP voltage
Characteristic: Logarithmic
Max. Sweep Range: 3¹/₃ decade
Input Resistance: 1 kΩ
Max. Sweep Frequency: Approx. 5 kHz
Sensitivity: 1V/frequency decade

General Specifications

Power Requirements

Voltage: 115, 230V ±15%
Power Consumption: 21W
Frequency: 50...100 Hz

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -4°C...+70°C
Size: 310 mm W x 140 mm H x 330 mm L (12.6 in W x 5.5 in H x 13 in L)
Weight: 4.5 kg (10 lb)
Included: Instruction manual, attached line cord.

Ordering Information

Model	January 1989 prices
PM 5131M Function Generator	$725

Accessories (Also see page 485)

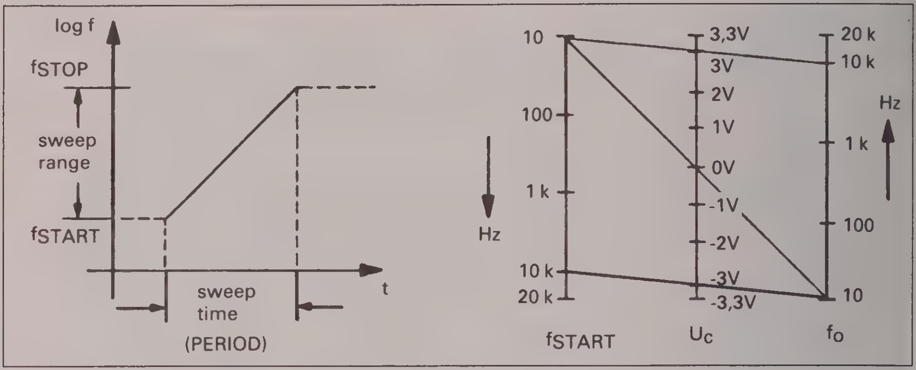
PM 9075 Cable BNC-BNC	11
PM 9560 19-in Rackmount Adapter	130

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.



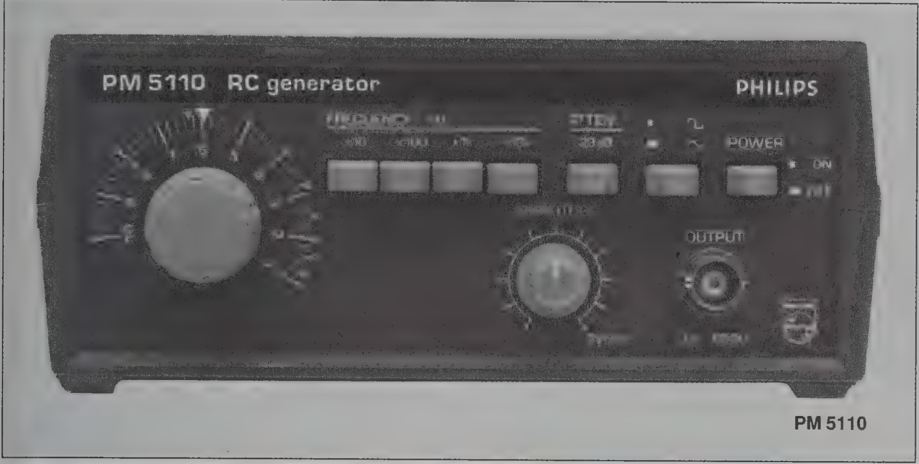
Example of internal single sweep

Internal single sweep from the start- to the stop frequency is started by pressing the button SGLE SWEEP. The characteristic is exponential following the relation $f_o = f_{START}\ 10^{U}C$ *where* f_o *= instantaneous signal frequency at the output;* f_{START} *= frequency at the beginning of the sweep represented by the frequency setting;* U_c *= voltage at the socket SWP VOLTAGE IN/OUT.*

Thus a control voltage difference of 1V results in a frequency ratio of 10:1.

At the end of the sweep the output remains at the stop frequency which can be set by the SWP STOP/START control. Resetting the SGLE SWEEP button causes the frequency to return to the start frequency. The sweep time is adjusted with the SWP PERIOD potentiometer. Pre-adjustment of the stop frequency may be performed at the end of the sweep with minimum period, prior to setting the final sweep operation.

The example shown is for the x10k frequency range; the other two ranges should be regarded similarly, with U_c *scale reading unchanged.*



PM 5110

PM 5110 Low Distortion LF Generator

- Sine and square wave signals
- Frequency range 10 Hz..100 kHz
- 6V pk-pk output and separate TTL output
- Very low distortion 0.02%
- Switchable 20 dB and continuous attenuation
- Compact dimensions and low weight

The PM 5110 has been designed for both educational applications and service work-shops. It provides square and sine wave signals, the latter having a special 'low distortion' position for use on HiFi development as well as alignment and maintenance. Another useful service feature is the switchable 20 dB attenuation.

The generator is 1 kg light and has very compact dimensions. The layout of the front panel is attractive and functional, a feature which is of particular value for educational applications.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 10 Hz...100 kHz (4 subranges, selectable by push-buttons)
Indication: Dial (1...10) LED marker
Setting Error: <4% ±1 Hz
Temperature Coefficient: <0.05%/K (1000 Hz)
Long-Term Drift: (<7h) <1.5 x 10^{-3} (1000 Hz)
Duty Cycle: 50% fixed

Waveforms

Sine wave
Square wave

Output

Attenuation: 20 dB calibrated step plus 40 dB continuously adjustable
Impedance: 600Ω
Short-Circuit Proof: Yes

Sine Wave

Low Distortion Mode: Total harmonic distortion 0.02% at 1 kHz; 0.03% (300 Hz...20 kHz)
Fast Settling Mode: Total harmonic distortion 0.5% (300 Hz...20 kHz)
Max. Open Circuit Voltage: 2 Vrms
Frequency Response of Amplitude: <2% (1000 Hz)

Square Wave

Max. Open Circuit Voltage: 4 Vp-p
Rise and Fall Time: <0.5 µs
Sag: <1% (50 Hz)
Duty Cycle: 50%

TTL

Amplitude High Level: 4.5V ±0.7V
Amplitude Low Level: <0.3V
Sag: <1%
Frequency Response: 3% (1000 Hz)
Rise Time: <30 ns
Fall Time: <15 ns
Fan Out: 10

General Specifications

Power Requirements

Voltage: 115, 230V ±15%
Power Consumption: 4W
Frequency: 60 Hz ±5%

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -40°C...+70°C

Size: 155 mm W x 65 mm H x 180 mm L (9 in W x 4.3 in H x 8.3 in L)
Weight: 1 kg

Included with instrument: Instruction manual, power cable

Ordering Information

Model	January 1989 prices
PM 5110M Oscillator Low Distortion	$325

Accessories (Also see page 485)

PM 9075 Cable BNC-BNC	11

Service & Support

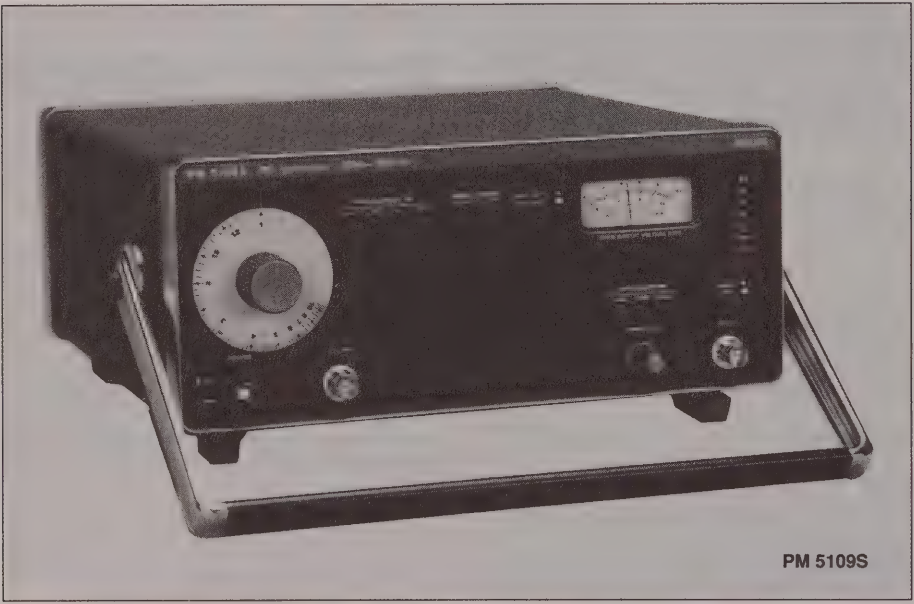
Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 5109/PM 5109S

PM 5109


PM 5109S

PM 5109/PM 5109S Low Distortion LF Generators

- Sine and square wave signals
- 10 Hz...100 kHz frequency range
- Output voltage: $30V_{p-p}$ (asymmetrical), $10V_{p-p}$ (symmetrical)
- Low distortion 0.02%
- Symmetrical floating output
- Output level indication
- Separate TTL and DIN loudspeaker output

The PM 5109 is an RC oscillator offering a low distortion (0.02% at 1 kHz) yet high, $30V_{p-p}$ (open circuit) output voltage in the asymmetrical mode. It can also be used in a fast settling mode, useful for fast routine work. These features, plus the facility to select asymmetrical or dual floating symmetrical outputs, make it ideal for telecommunication applications as well as for education, R & D, manufacturing and audio equipment servicing. Both output voltages can be attenuated by a continuous control; the asymmetrical output can also be attenuated in steps of 10 dB down to 60 dB. Both pure sine waves or square wave signals are available at frequencies from 10 Hz to 100 kHz; output impedance is switchable for either 600Ω or 50Ω in the asymmetrical mode and 600Ω or LOW Z in the symmetrical mode (see specification).

A DIN loudspeaker connection is provided, which has an impedance similar to the symmetrical low impedance output. This allows direct testing of loudspeakers, regardless of their impedance. A special TTL output for direct connection to TTL circuitry or for synchronization purposes, is also provided.

The open circuit output is monitored by a meter on the front panel and the output range in use is indicated by the appropriate LED, from the seven provided.

For applications where the symmetrical output is not required, a special, economical, version, the PM 5109S is available.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 10 Hz...100 kHz
(4 subranges, selectable by push-buttons)
Indication: dial (1...10)
Setting Error: <±5% ±1 Hz
Temperature Coefficient: <0.05/K
Long Term Drift (<7h): $<1.5 \times 10^{-3}$
Short Term Drift (<15 min): $<0.5 \times 10^{-3}$
Duty Cycle: 50% fixed

Waveforms

Sine wave
Square wave (output B only)

Output

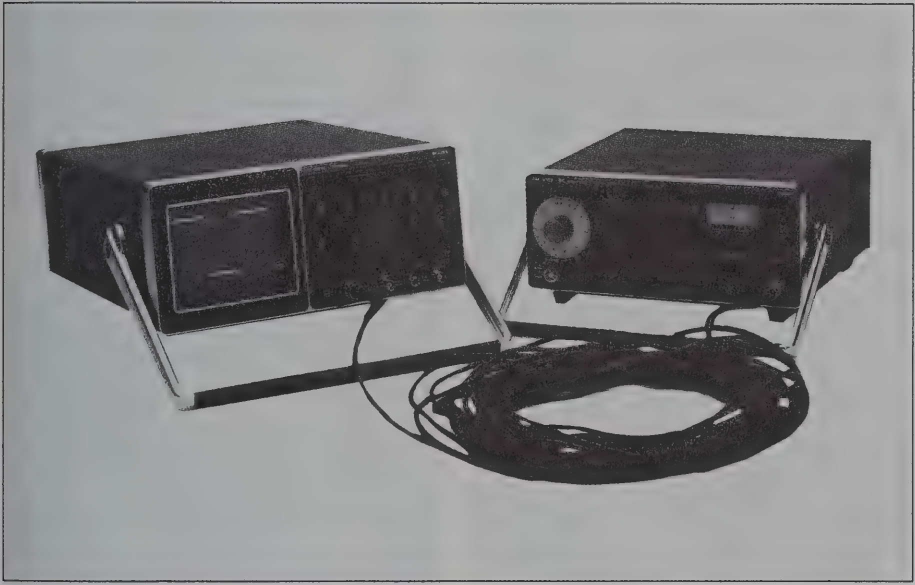
Separate outputs selectable with push-buttons
Symmetrical Output: (4 x 4 mm connector on front panel) (PM 5109 only)

a. 2x 300Ω
b. 300Ω + 300Ω
c. 2 x low Z
d. low Z + low Z
} not grounded

Asymmetrical Output:
(BNC connector at front panel)
a. 600Ω
b. 50Ω

PM 5109/PM 5109S

Loudspeaker Output: (DIN connector at rear panel) Only active when output Ad is selected
TTL Output: (BNC connector at rear panel)
Open Circuit Output Voltage: (RMS)
0.03...3.16V (output A)
0.1...10V (output B)
Indication: Meter (7 ranges indicated by LED)
Attenuation: 10, 20, 30 dB calibrated steps selectable in any combination (output B only) plus 30 dB continuously adjustable



PM 5109 being used to check the bandwidth characteristic of a long coaxial cable.

Sinewave

Total Harmonic Distortion
(for output Aa, Ab, and B)

- low distortion mode
<0.7% (10 Hz...100 kHz)
<0.03% (300 Hz...20 kHz)

- fast settling mode
<1.5% (10 Hz...100 kHz)
<0.5% (100 Hz...100 kHz)

Total Harmonic Distortion
(for output Ac and Ad)

- low distortion mode
<0.7% (open circuit 20 Hz...100 kHz)
<0.03% (open circuit 300 Hz...20 kHz)
<0.15% (4Ω load, 20 Hz...100 kHz)

- fast settling mode
0.5% (0...4Ω load, 100 Hz...100 kHz)

Frequency Response of Amplitude
±0.2 dB (1 000 Hz, outputs A & B, open circuit)
±0.5 dB (10 Hz...10 kHz, outputs Ac & Ad, 4Ω load)
- 6 dB (70 kHz, outputs Ac & Ad, 4Ω load)

Squarewave

Rise and Fall Time: <0.5 μs
Overshoot and Ringing: <2% (>20 Hz); <1% (>50 Hz)

TTL

Duty Cycle: 50%
Fan Out: 20

Power Requirements

Line Voltages: 110, 128, 220, 238V ±10%
Frequency: 50...100 Hz
Power Consumption: 17W
Dimensions: 310 mm W x 140 mm H x 330 mm L (12.2 in W x 5.5 in H x 13 in L)
Weight: PM 5109: 6.5 kg (14.3 lb);
PM 5109S: 5 kg (11 lb)

Included with instrument: Instruction Manual, line cord

Ordering Information

Models

January 1989 prices

PM 5109 RC Generator and Output Monitor	$1200
PM 5109S RC Generator 10 Hz - 100 kHz	1000

Accessories (Also see page 485)

PM 9075 Coaxial Cable BNC-BNC	11
PM 9560 19-inch Rackmount Adapter	130

Service & Support

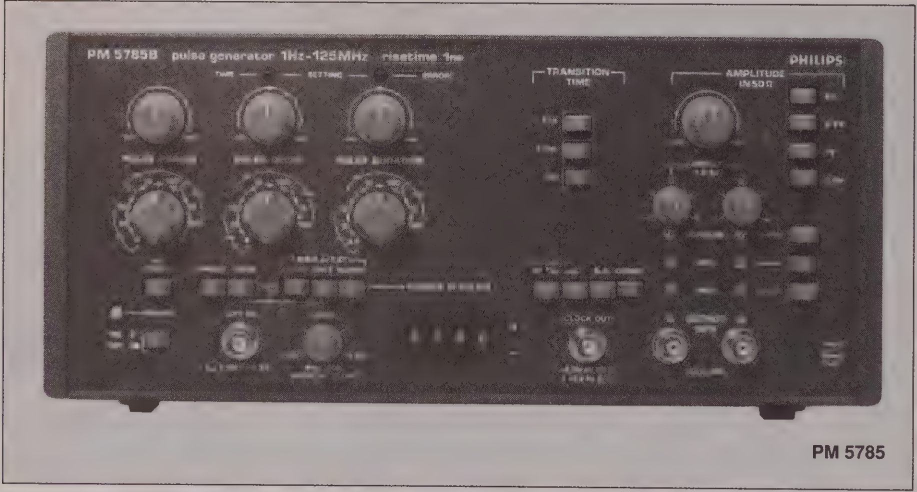
Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5785 & PM 5786

PM 5786



PM 5785

PM 5785/PM 5786 125 MHz Pulse Generators

- 1 Hz...125 MHz pulse frequencies
- Rise and fall times from 1 ns
- Time-setting-error indicators
- Excellent 50Ω backmatching
- Dual outputs for simultaneous + and - pulses
- Full external control facilities
- LED indicator for correct trigger levels
- Presettable burst option

PM 5785 and PM 5786: top performance, top economy and assured time-settings.

The PM 5785 and PM 5786 have the speed and versatility to handle virtually any analog or digital circuit testing requirement. Yet, for instruments with such high performance, they are very competitively priced. Fast digital circuitry such as TTL or ECL is easily handled by both generators, and the wide choice of external trigger and gate functions make the setting up of special test signals unbeatably easy.

The difference in the PM 5785 and PM 5786 is the choice between speed and versatility in leading and trailing edge adjustment.

The PM 5785 offers the higher speed of the two. Its leading and trailing edges are equal. Pulse transition times can be selected from three values: 1 ns, 1.5 ns or 2 ns.

The PM 5786 offers a whole-spectrum of transition times from which to choose. It allows such versatility as independent and continuous variable settings of rise and fall times all the way from 2 ns ... 100 ms. In other words, the PM 5786 is best suited for high-speed general-purpose applications such as in research and development, where many different pulse response tests may need to be made.

On the other hand, the 1 ns performance of the PM 5785 is ideal for ultra high-speed testing in quality control (manufacturing), performance checks (maintenance) or testing to limits (development).

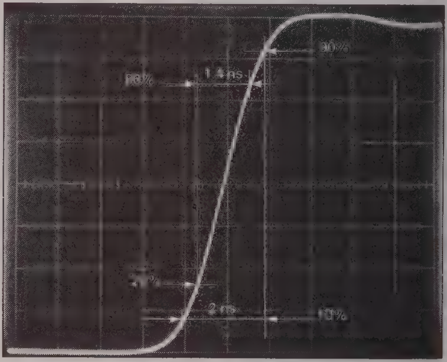


Fig. 1.

Ease of Operation

Both PM 5785 and PM 5786 offer features to simplify operation. Like the unique system of front panel time-setting-error indicator LEDs to provide clear confirmation that all time settings are correct. This prevents erroneous pulses, caused by incorrectly set pulse duration or pulse delay times (and additionally for the PM 5786, rise and fall times) with respect to pulse period.

Versatile Pulse Selection

Additional ease of use results from simple and versatile selection of the desired kind of output pulses: bipolar, positive or negative. Simultaneous positive and negative going pulses can be selected for linear applications, as well as complementary positive or negative pulses for digital applications.

This simple output selection means there is no need for time-consuming manual adjustment of inverter and offset controls. Further, logic 'O' and '1' levels can be changed without the need for interchanging cables by using the COMPL (normal/complementary) switch. The table below, shows the possible output combinations that can be selected.

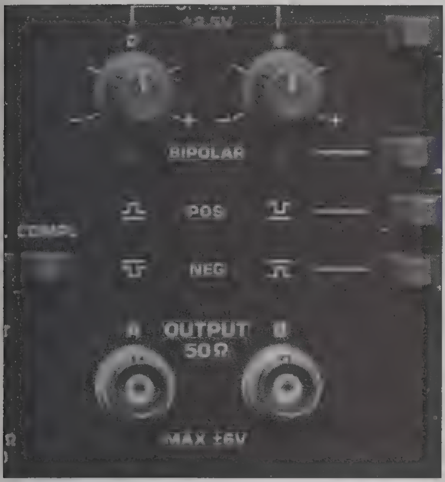


Fig. 2. Shows dual output arrangements with output and pulse mode selectors.

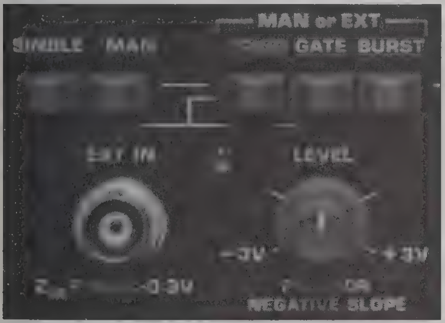


Fig. 3. Shows selection of various external control functions and the external control input.

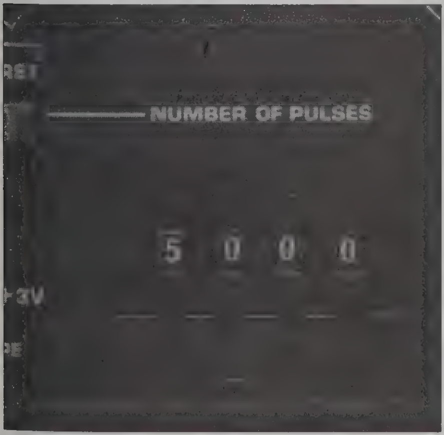


Fig. 4. Option burst function and thumbwheel control.

High-Speed, High-Fidelity Pulses

The PM 5785's ultra high-speed output waveforms have rise and fall times selectable from 1 ns, 1.5 ns and 2 ns, (and with the 20% ... 80% transition times for ECL testing, rise and fall times are 700 ps, 1 ns and 1.4 ns).

A choice of bipolar outputs and high-quality 4-range output attenuator in both the PM 5785 and PM 5786 make these generators very suitable for all kinds of linear applications. Very clean pulses are ensured by the PM 5786's excellent back-matching impedance that absorbs over 90% of reflections from mismatched loads, while the PM 5785 absorbs as much as 95% of reflections.

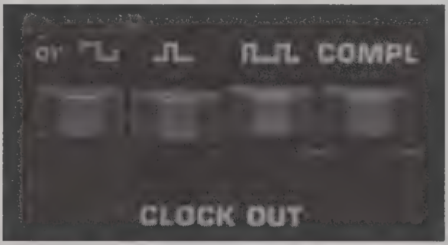


Fig. 5. Pulse mode selectors.

Burst Mode

The PM 5785 and PM 5786 are also available with burst mode options (PM 5785B and PM 5786B), that enable generation of bursts containing selectable numbers of pulses from 1...9999. Pre-selection of the required number of pulses is easily carried-out, using front panel digital switches. Bursts can be triggered either manually or remotely by a signal to the EXTernal INput on the front panel. The use of the presettable burst mode is particularly valuable, for testing memory circuits, shift registers, counters and other digital circuits.

Other functions which can be selected and carried out remotely through the external input include:

- Externally triggered pulses
- Externally gated pulses (gives synchronized bursts of pulses)
- Externally controlled pulse duration.

External control signals can be applied to define the start (and duration) of the various control options. Start/stop conditions can be adjusted with the EXT IN LEVEL control both to select +/- trigger slope and -3V...+3V trigger level. An LED indicates correct triggering.

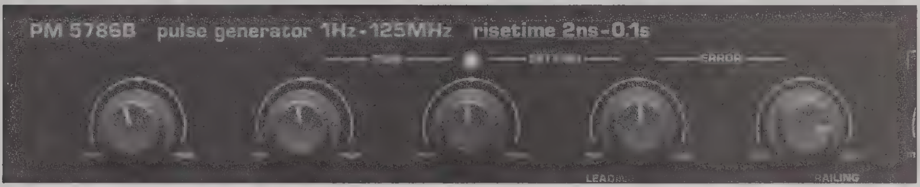


Fig. 6. Time setting errors are indicated by LEDs.

Mode	Normal		Complementary	
Output	A	B	A	B
Bipolar	⊓	⊔	⊔	⊓
Pos	⊓	⊔	⊔	⊓
Neg	⊔	⊓	⊓	⊔

PM 5785 & PM 5786

External Triggering

External triggering enables the PM 5785/ PM 5786 to operate synchronously with external clock signals. All other parameters, such as pulse duration, amplitude etc. are as set on the pulse generator. External trigger signals can vary from 0...125 MHz, or, in the double pulse mode, 0...62.5 MHz.

External Gating

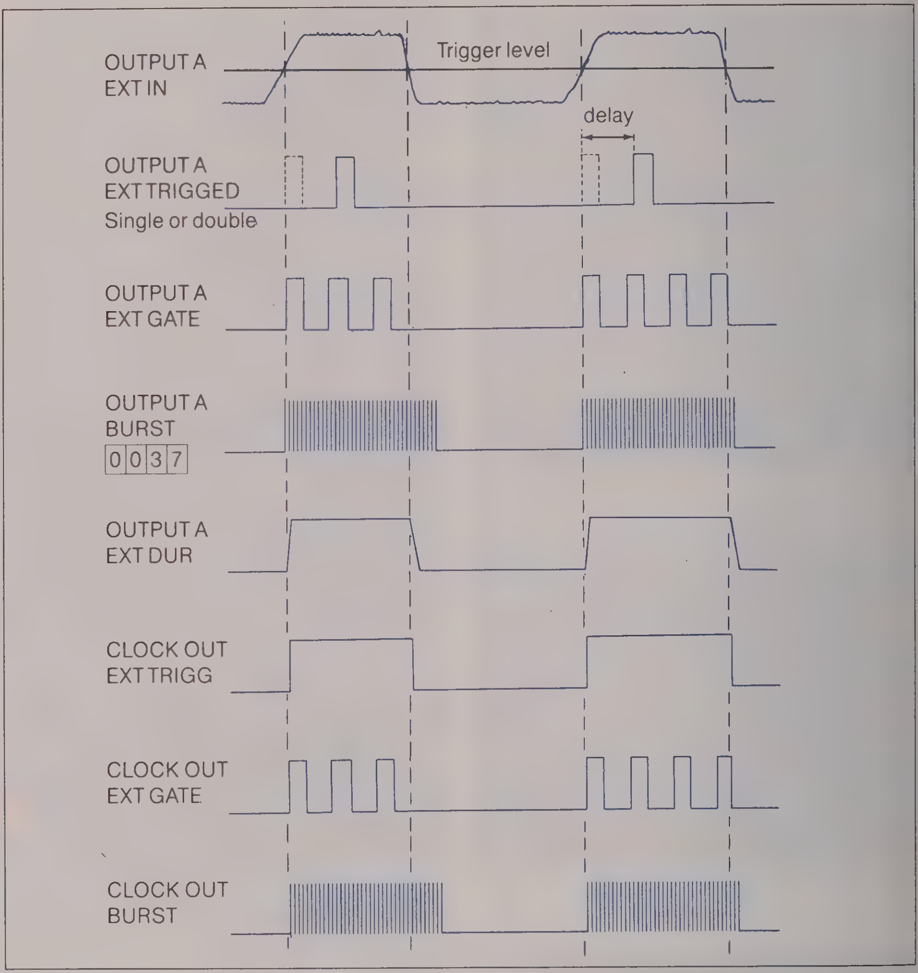
The external gate mode provides external synchronous on/off control of the pulse generator. As long as the external gate signal is present, output pulses are available with the preset pulse parameters.

External Duration

This mode allows the generators to function as input signal conditioners. The external input signal defines frequency and pulse duration, while amplitude, DC offset, rise and fall times and normal/complementary mode selection are defined by the pulse generator settings.

Squarewave Mode

A 'squarewave' mode provides pulses with a constant 0.5 duty factor. This facilitates a quick method of setting the required output repetition rate, without having to consider the other time parameters.



Specifications

Technical Specifications

Time Parameters

Pulse Repetition Period: 8 ns...1s (1 Hz...125 MHz)
Pulse Delay: 8 ns...100ms
Pulse Duration: 3.5 ns...100 ms or fixed square wave
Jitter: <0.1% of setting ±50 ps

Main Output Pulse Characteristics

Outputs: 2 channels, A and B
Transition Times: At $Z_L = 50\Omega$
PM 5785: 1 ns, 1.5 ns or 2 ns fixed selectable, corresponding to 10%...90% of pulse amplitude. For ECL testing: 700 ps, 1 ns or 1.4 ns fixed selectable, corresponding to 20%...80% of pulse amplitude.
Transition Time Accuracy: ±10% (PM 5785)
PM 5786: <2 ns...>100 ms, continuously variable, corresponding to 10%...90% of pulse amplitude.
For ECL testing: the minimum transition time is 1.4 ns, corresponding to 20%...80% of pulse amplitude.
Pulse Amplitude: 0.2V...5V (at $Z_L = 50\Omega$), double amplitude at open output
DC Offset: -2.5V...+2.5V (at $Z_L = 50\Omega$), ±5V at open output
Max. Output Voltage: Pulse amplitude plus DC offset is ±6V at max. Maximum 10V open output voltage within the -6v...+6V range.
Waveform Aberrations: at $Z_L = 50\Omega$
PM 5785: <5% ±10 mV
PM 5786: <5% ±10 mV, <10% for transition times <5 ns
Source Resistance: 50Ω ±5%
Source Impedance:
PM 5785: 50Ω ±5%
PM 5786: 50Ω ±10%
Output Protection: against short- or open- circuit and transients
Pulse Modes:
- Single pulse (delayable)
- Double pulse
- Square wave: 50% ±1% (1 Hz...1 MHz); 50% ±10% (1 MHz...125 MHz)
- Normal or complementary switchable

Output Modes:
Bipolar: simultaneously positive and negative polarity
Pos: positive polarity, normal and complementary
Neg: negative polarity, normal and complementary

External Operating Modes

TRIGG: Ext. triggered pulse repetition: DC...125 MHz or manual single shot
GATE: Synchronous gating. Ext. input signal starts and stops the generator
BURST: Internally generated burst with digital switch selection of number of pulses: 0...9999, started by ext. input signal or manual control
EXT DUR: External duration gives pulses with same duration and repetition rate as external input signal, all other pulse parameters are set via the generator

External Input

Range: DC...125 MHz; min. pulse duration 3.5 ns
Operating Input Voltage Range: 0.5...15 Vpp
Coupling: DC
Input Impedance: 1 MΩ//25 pF
Trigger Level: -3V...+3V
Trigger Slope: + and -
Trigger Indicator: Tri-state LED indicator for correct trigger level setting
Max. Input Voltage Without Damage: 260 Vrms at ≤440 Hz, declining to 15 Vpp at 125 MHz

Internal Clock Output

Main output pulse is delayable with respect to internal clock output, which can thus be used as pre-trigger
Amplitude: +2.5V into 50Ω
Output Impedance: 50Ω (typ)
Transition Time: Approx. 1 ns
Pulse Duration: Square wave, 50% ±1% (1 Hz... 1 MHz), 50% ±10% (1...125 MHz)
Output Protection: Against short- or open- circuit and transients

Time Setting Error Indicators

Warning with LED indicators for erroneous settings of too long times for pulse delay and/or pulse duration (on PM 5785 and PM 5786) as well as for leading- and trailing edge transition times (PM 5786 only).

General Specifications

Power Requirements

Line: 100V, 120V, 220V and 240 Vrms ±10%; 120 VA, 50...60 Hz
Safety: According to IEC 348 and CSA 556B
Mains Interference: Below VDE 0871 (B) and MIL STD 461A

Environmental Conditions

Temperature:
Rated Range of Use: 0°C...+50°C
Storage and Transport: -40°C...+70°C
Humidity:
Operating: 10...90% RH, no condensation
Storage: 5...95% RH
Altitude/Barometric Pressure:
Operating: 5000m (15000 ft) - 53.3 kN/m2
Storage: 15000m (50000 ft) - 15.2 kN/m2
Size: 300 mm W x 145 mm H x 470 mm L (11.8 in W x5.7 in H x 18.5 in L)
Weight:
Net: 9.5 kg (21 lbs)
Shipping: 11.5 kg (25 lbs)
Included with instrument: Manual, power cord

Ordering Information

Models

January 1989 prices

PM 5785/00 1 ns Pulse Generator; excluding preset burst unit	$3385
PM 5785B/00 1 ns Pulse Generator; including preset burst unit	3790
PM 5786/00 2 ns Pulse Generator; excluding preset burst unit	3385
PM 5786B/00 2 ns Pulse Generator; including preset burst unit	3790

Accessories (Also see page 485)

PM 9581/01 50Ω Feed-through Termination; 3W	60
PM 9584/02 50Ω T-piece (matched power-splitter)	52
PM 9585/01 50Ω Feed-through Termination; 1W	30
PM 9588/01 50Ω Coaxial Cable Set with calibrated delay times	265

Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5716

PM 5716

PM 5716 50 MHz; ±20V Pulse Generator

- 1 Hz...50 MHz repetition rate
- 6 ns...100 ms rise and fall times
- 2V..20V amplitude, within the range of -20V...+20V
- Independent control for upper and lower pulse levels
- Pulse amplitude limiter to protect device under test
- Built-in 50Ω backmatch, no need for external termination
- Versatile facilities for external triggering, gating and pulse amplifying

This truly universal pulse generator has been designed to meet all MOS logic testing requirements as well as TTL and other HNIL circuits.

It meets the exacting performance criteria demanded by this wide range of devices without any sacrifices of, for instance, fast transition times or special outputs for TTL.

Moreover, the wide range of repetition rates, delay, duration and transition times makes the PM 5716 an ideal pulse source also for analog applications.

This instrument therefore introduces a new dimension to the existing range of Philips pulse generators and new standards in pulse generator design and performance.

Pulse Amplitudes to 20V

The main pulse amplitude from the PM 5716 is continuously adjustable between 2V and 20V.

The pulse level setting is done with two independent sliding potentiometers with ranges from -20V to +20V. The two sliders are mechanically interlocked in such a way that they cannot pass each other and the maximum separation corresponds to a 20V pulse amplitude. (Fig. 1)

The generator has a source impedance of 50Ω and the maximum output amplitude is 20V into ≥5 kΩ. Into 50Ω this value is 10V. The front panel scale is graduated for both cases. The very good output stage of the PM 5716 maintains the 20V pulse amplitude over the whole frequency range.

The PM 5716 is designed for ease of operation. The square wave pulse mode gives freedom from selecting delay and duration; the operator need only set the repetition time, amplitude and shortest transition time and the pulse output.

As can be seen from the illustration it is easy to read pulse amplitude directly from the scales.

By avoiding the use of double function controls the PM 5716 has become an instrument which is very convenient to operate.

Amplitude Limiter

The PM 5716 has as standard an amplitude limiter to protect the device under test. (Fig. 2) When the MOS supply voltage is connected to the limiter inputs your circuits are automatically safeguarded against excessive pulse levels.

The pulse levels can not exceed the upper/lower levels of the limiting voltages. This makes it possible also to remotely control the output levels within the range set by the sliders.

Backmatched 50Ω Output

The built-in 50Ω termination in the PM 5716 is compensated for the reactive impedance components of the output stage.

Fig. 3 which shows a 20V pulse with 6 ns rise time fed into a 1 meter open ended cable, illustrates how the internal termination absorbs the reflection. The residual reflection from the PM 5716 is guaranteed to be less than ±3% with this set-up.

This backmatch makes it possible to work with unterminated cables and high ohmic loads without spending time on checking the waveform.

The benefits gained from this specially designed output are summarized as follows:

- Reflections from all kind of mismatches are absorbed in the generator
- Gives a better waveform, less dependent on external load
- The fixed load means protection of the output stage
- Ideal for high ohmic loads such as MOS circuits
- No need for external termination — easier to use

Transition Times

In the PM 5716 the transition time is not dependent on the amplitude.

This gives freedom to vary the amplitude during a test sequence without having to check and readjust the rise and fall time.

The repetition and transition time ranges in the PM 5716 far exceed the requirements for the MOS logic of today. This makes the generator a suitable pulse source for new developments in MOS in the years to come. The very good characteristics of the rise time circuit are obvious. Linearity is excellent and the pulse has hardly any over shoot.

High Ohmic Trigger Input

In logic testing it is often desirable to trigger a pulse generator from the circuit under test. The trigger take-off must then be of sufficiently high ohmic value to avoid overloading the circuit under test. The PM 5716 has for that reason a trigger input impedance of 1 MΩ//20 pF which is suitable for MOS logic.

The trigger level in the PM 5716 is variable from -2V to +2V enabling triggering from all kinds of logic and most analog sources.

PM 5716

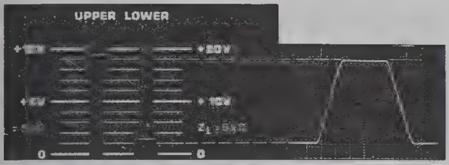


Fig. 1. Independent slide potentiometers for setting maximum and minimum pulse levels.

Clock and Auxiliary Outputs

The auxiliary output of the PM 5716 gives a +2.5V pulse into a 50Ω load. As the source is backmatched by 50Ω a +5V amplitude across high ohmic loads is available.

The pulse always has set delay and duration and a 6 ns transition time.

The clock output always gives symmetrical pulses which are suitable for use as a time reference, because of the fixed duty factor.

Output Protection

The reliability of a signal source is most important. But pulse generator outputs exposed to all kind of reflections, external DC-levels and transients, have always been difficult to safeguard.

The PM 5716 includes an output protection system of diodes shorting any external transients applied to the internal supply voltage. In the case of external DC-levels, the whole internal voltage supply (which is floating) is shifted to avoid overload of the output transistors. The two 5V outputs are also protected with diodes against external transients.

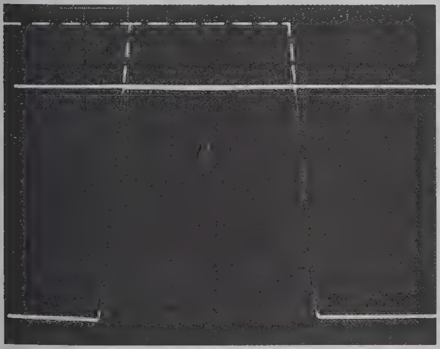


Fig. 2. Pulse limiter protects MOS circuit under test against excessive input pulse amplitudes.

Specifications

Technical Specifications

Repetition Rate

Internal: 1 Hz...50 MHz variable in 8 ranges with continuous control within the ranges
Jitter: ≤0.1% or 50 ps whichever is greater
External: DC...50 MHz

Pulse Delay

10 ns...100 ms. Variable in 7 ranges with continuous control within the ranges.
Jitter: ≤0.1% or 50 ps whichever is greater

Pulse Duration

10 ns...100 ms. Variable in 7 ranges with continuous control within the ranges.
Jitter: ≤0.1% or 50 ps whichever is greater.
Duty Factor: More than 50%. Duty factor over 99% possible with complementary mode.

Main Output Pulse Characteristics

Amplitude: 2V...20V between -20V and +20V with 5 kΩ load
1V...10V between -10V and +10V with 50Ω load
Rise and Fall Times: ≤6 ns...100 ms, (at amplitude below 4V (2V) from 8 ns).
Independent continuous controls within 8 selectable ranges. The transition time remains constant when the pulse amplitude is varied.
Source Impedance: 50Ω compensated, ideal for driving MOS circuits without terminating load. A total reflection of a 6 ns rise time pulse gives less than ±3% distortion.
Waveform Aberrations: ≤5% for all transition times
Amplitude Limiter: The upper (lower) pulse level may be limited by an external DC-source to any value between +20V and -18V (+18V and -20V). With high ohmic load the max. output level is equal to the limiter levels. With 50Ω load, 50% of the levels.
The input resistance of the limiter measured between upper or lower terminals and earth is ≥1 kΩ.
Protection: Short and open circuit safe
Protected against external DC-voltages between ±20V. Special transient protection circuits built in.
Timing: The pulse is delayed 50 ns plus set delay from an external trigger pulse.

Clock Pulse Characteristics

Amplitude: +2.5V into 50Ω and 5V into 5 kΩ
Source Impedance: 50Ω
Rise and Fall Times: Approx. 6 ns
Duty Factor: 50% ±5% (in fastest range 25-45% duty factor)
Protection: Short and open circuit safe, diode protection against transients
Timing: Pulse occurs approx 35 ns plus set delay ahead of main pulse and 15 ns after external trigger pulse

Auxiliary Pulse Characteristics

Amplitude: +2.5V into 50Ω and +5V into 5 kΩ
Source Impedance: 50Ω
Rise and Fall Times: Approx 6 ns
Duty Factor: As set by 'DURATION'
Pulse Mode: Single or double pulses
Protection: Short and open circuit safe, diode protection against transients
Timing: Pulse occurs approx 15 ns plus set delay ahead of main pulse and 35 ns after external trigger pulse

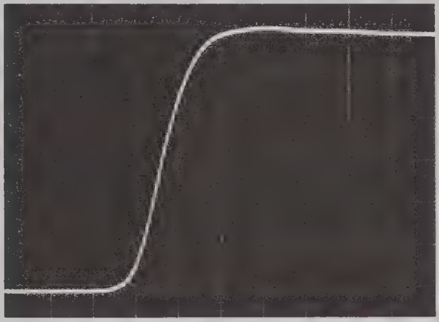


Fig. 3.

External Triggering/Gating

Electrical: Frequency range: DC...50 MHz
Sensitivity: 200 mV
Trig Level: Variable -2V to +2V, with 10:1 probe -20 to +20V
Trig Slope: Selectable leading or trailing edge
Max. External Voltage: ±20V
Input Impedance: 1 MΩ//20 pF suitable for probes
Manual: Single shot by means of push button

Modes of Operation

1	INT CLOCK	Internal clock gives repetition rates from 1 Hz to 50 MHz
2	MAN TRIGG	Manual trigger gives one single/double pulse with set duration or one pulse with same duration as the manual trigger pulse.
3	EXT GATE _⊓_ ‾⊔‾	Gated pulses. First pulse coincides with leading/trailing edge of gate pulse.
4	EXT TRIGG ⟋ ⟍	Triggering on leading/trailing edge of external pulse.
5	EXT DUR	Pulses with same duration and repetition rate as external pulses.

Pulse Modes

1	⊓⊔	Gives a square wave on main output (50% ±5%; approx 25% duty factor in fastest range). And gives single pulses with set duration on aux. output.
2	_⊓_	Gives single pulses with set duration on both main and aux. output.
3	⊓⊔⊓_	Gives double pulses with set duration on both main and aux. output.
4	NORM	'Normal' gives pulses as previously described.
5	COMPL	'Complementary' gives the complement to the set pulse on main output only.

PM 5716

General Specifications

Line Voltages: 85V...115V, 100V...130V, 200V...265V; switchable
Frequency: 50 Hz or 60 Hz solderable
Power Consumption: 90 VA
Size: 280 mm W x 133 mm H x 360 mm L (11 in W x 5.2 in H x 14.2 in L)
Weight: 9 kg (19.8 lb)

Ordering Information

Model

January 1989 prices

PM 5716/00 Pulse Generator	$3375

Accessories (Also see page 485)

PM 9581/01 50Ω Feed-through Termination 3W	60
PM 9584/02 50Ω T-piece (power splitter)	52
PM 9585/01 50Ω Feed-through Termination 1W	30
PM 9588/01 Coaxial Cable Set (5x1 ns, 4x2 ns, 3x3 ns, 3x10 ns)	265

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5712 & PM 5715

PM 5712
PM 5715

PM 5712 & PM 5715 50 MHz Pulse Generators

Frequency range: 1 Hz ... 50 MHz

Rise/fall times: PM 5712, 4 ns fixed; PM 5715, 6 ns ... 500 ms, variable

Amplitude range: 0.2 ... 10V

DC offset: +2.5V

Facilities for: manual and ext. triggering, gating, pulse shaping

Pulse modes: single/double, norm/inverted, pos/neg

Applications

The universal 50 MHz pulse generators PM 5712 and PM 5715 have been designed for medium fast, pulse response testing applications.

They can handle virtually any analog or digital circuit testing requirement up to 50 MHz. Their speed and the wide 0.2 ... 10V output voltage range makes these generators ideal for testing of all MOS- and TTL- compatible circuits.

A second output (auxiliary output) supplies pulses, similar to the main output pulses, yet with fixed TTL-compatible levels.

The capability of producing double pulses, with variable delay, allows these instruments to be used for analysis of pulse pair resolution of digital and analog circuits.

An adjustable DC offset can be used to test circuit tolerances for variations in logic levels.

Their versatility is enhanced by extended facilities for external control of e.g. manual and external triggering, synchronous gating and external duration (pulse shaping).

PM 5712 Versus PM 5715

The main difference between the models is found in the facility for transition time setting.

The PM 5712 is primarily intended to supply pulses of positive polarity. However, negative pulses up to -5V can be generated by use of the DC offset and the normal/inverted switch.

The PM 5712 offers a fixed rise- and fall-time of 4 ns. Compared to the PM 5715, this unit is somewhat faster and is more economically priced.

This makes the PM 5712 ideal for go/no-go and performance limit tests, such as those in quality control (manufacturing) and performance checks (maintenance).

On the other hand, the PM 5715 covers a much wider spectrum of applications. It features continuously variable settings of transition times, all the way from 6 ns to 500 ms, with separate controls for rise- and fall-time.

In addition, the PM 5715 allows selection of both positive and negative pulses, over the full pulse amplitude range of -10 to +10V.

In other words, the PM 5715 is best suited for general-purpose applications such as in research and development, where a wide variety of different pulse response tests may need to be made.

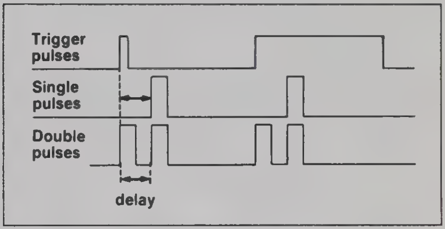
PM 5712 and PM 5715

Both models offer three different pulse modes to select from:
- Single pulses
- Double pulses
- T/2 pulses

Testing of digital circuitry is facilitated by the possibility to select of either normal or inverted pulses and the variety of external control facilities.

Single Pulse Mode

In the single pulse mode, continuous pulses up to 50 MHz are generated with adjustable repetition time. Also pulse duration and delay (with respect to the sync. output) are variable.



Double Pulse Mode

In the double pulse mode, twin pulses are generated, of which the pulse pair frequency is variable up to 25 MHz. The pulse duration is commonly set for both pulses, while the delay between the pulses is variable.

Square-Wave or T/2 Mode

In the T/2 mode, the generators supply fixed square wave pulses, irrespective of the settings for pulse delay and pulse duration.

Normal/Inverted

An additional normal/inverted switch allowing the logic state of the pulses to be changed. In the normal mode, the generators can supply pulses with duty cycles of from nearly 0% to more than 50%, whilst in the inverted mode, duty cycles of nearly 100% can be obtained.

External Triggering

External triggering enables the PM 5712/ PM 5715 to operate synchronously with external clock signals. All other parameters, such as pulse duration, amplitude, etc. are set on the pulse generator. External trigger signals can vary from 0 ... 50 MHz or, when in the double pulse mode, 0 ... 25 MHz.

External Gating

The external gate mode provides an external synchronous on/off control over the pulse generator. Bursts of output pulses are supplied, only during the presence of the external gate signal. The first pulse coincides with the trailing edge of the gating signal, the last pulse is completed even if the gating signal ends during the pulse.

External Duration

Simultaneous selection of external triggering and the T/2 mode enables the generators to function as input signal conditioners. The external input signal defines frequency and pulse duration, while amplitude, DC offset, rise- and fall-time and normal/inverted mode selection are defined by the pulse generator settings.

PM 5712 & PM 5715

Specifications

Technical Specifications

Time Parameters

Pulse Repetition Time: 20 ns ... 1s (1 Hz ... 50 MHz)
Pulse Delay: 10 ns ... 100 ms
Pulse Duration: 10 ns ... 100 ms

Transition Times Main Output: Corresponding to 10 ... 90% of pulse amplitude, at amplitudes of ≤5V and Z_L = 50Ω
PM 5715: 6 ns ... 500 ms
PM 5712: 4 ns fixed

Jitter: ≤0.1% of setting ±50 ps

Main Output Pulse Characteristics

Pulse Amplitude: 0.2V ... 10V at Z_L = 50Ω
Polarity:
PM 5715: + or - switchable
PM 5712: + only. Pulses within -5V ... +10V possible, using DC offset and norm/inv

Transition Times: Corresponding to 10 ... 90% of pulse amplitude, at amplitudes of ≤5V and Z_L = 50Ω
PM 5715: 6 ns ... 500 ms
PM 5712: 4 ns fixed

DC Offset at Z_L = 50Ω:
PM 5715: -2.5V ... +2.5V
PM 5712: -5V ... +2V

Max Output Voltage: Pulse amplitude and DC offset max. +10V
Waveform Aberrations:<±5% of set amplitude
Source Impedance: Current source of 200 mA in 10V range, terminated with internal 50Ω in 5V and lower ranges.
Pulse Modes:
- Single pulse (delayable)
- Double pulse
- T/2, 50% duty cycle, 50 ±20% duty cycle in 20 ns and 100 ns repetition range

Logic Mode: Normal or inverted
Output Protection: Against short or open circuit

Auxiliary Pulse Output Characteristics

Pulse Amplitude: TTL-compatible, +2.5V into 50Ω or +4.5V open circuit
Source Impedance: 50Ω
Pulse Modes: Single pulse, double pulse, not T/2. The pulse occurs approx. 12 ns ahead of main pulse.
Output Protection: Against short or open circuit

Sync. Output

Function: Pre-trigger output, main output pulse is delayable with respect to sync. output
Amplitude: +1.5 V at Z_L = 50Ω, +3V open circuit
Output Impedance: 50Ω
Pulse Duration: Square wave
Output Protection: Against short or open circuit

External Operating Modes

TRIGG: Ext. triggered pulses, range: DC... 50 MHz or manual single shot
GATE: Synchronous gating, external signal starts and stops the generator
EXT DUR: External duration gives pulses with same duration and repetition rate as external input signal, all other pulse parameters are set via the generator

External Input

Function: For external trigger, gate and duration
Range: DC ... 50 MHz
Coupling: DC
Input Impedance: Approx 220Ω at <1.5V, approx 800Ω at >1.5V
Trigger Level: ≥+1V
Trigger Slope: Positive
Max. Input Voltage Without Damage: ±12V

General Specifications

Power Requirements

Line: 100 ... 130V and 200 ... 260V switchable, 85 ... 115V and 170 ... 230V solderable
Line Frequency: 50 ... 400 Hz
Power Consumption: 70 VA

Environmental Conditions

Temperature Range:
Operating: 0...40°C
Storage: 0...70°
Size: 210 mm W x 130 mm H x 275 mm L (8.3 in W x 5 in H x 10.8 in L)
Weight: 4 kg (8.8 lb)

Included with instrument: Manual, power cord

Ordering Information

Models

January 1989 prices

PM 5712/08 Pulse Generator	$1485
PM 5715/11 Pulse Generator	1745

Accessories (Also see page 485)

PM 9581/01 50Ω Termination (3W)	60
PM 9585/01 50Ω Termination (1W)	30
PM 9588/01 Coaxial Cable Set	265
PM 9584/02 50Ω T-Piece	52

Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5705

PM 5705 10 MHz: 15V Output Pulse Generator

- 0.1 Hz...10 MHz frequency range
- TTL-compatible outputs, both normal and complementary
- 1.0V to 15V into 50Ω for TTL, HNIL and MOS applications
- Baseline offset from 0 up to +2V
- Resettable, engraved scales
- External triggering on positive or negative slope; gating and single shot facilities

The PM 5705 is an ideal low-cost generator for a wide range of TTL MOS and HNIL applications. There are two TTL outputs, normal and complementary with sufficient power for up to 30 gates.

For MOS and HNIL logic there is a 1 to 15V output. For current sink applications a 50Ω internal switchable load is included. This all-round performance is complemented by a logical front panel layout and the use of engraved, resettable scales.

These allow the pulse parameters to be set to a high degree of accuracy without employing an oscilloscope. This feature is particularly useful for educational applications. When the PM 5705 is used as a clock generator only the repetition time has to be set and the square wave push button depressed.

The baseline offset of up to 2V is an additional useful feature, used to test biased circuits and components — for example the (zero) level in TTL.

Pulse bursts can be produced using an LF generator connected to the trig/gate input. The PM 5705 can also be triggered by an external pulse source, on either the positive or negative slopes.

Specifications

Technical Specifications

15V Pulse Output

Repetition Rate: 0.1 Hz...10 MHz variable in 8 ranges with continuous control within the ranges. Jitter less than 0.1%

Duration: 50 ns to 500 ms variable in 7 ranges with continuous control within the ranges. Jitter less than 0.1%

Duty factor approaching 100% using complementary pulse. More than 50% in normal pulse mode

Delay: In square wave mode the positive edge of the TTL complementary is delayed from the complementary main pulse. The delay time is the set duration subtracted from half the repetition time.

Amplitude: Continuously variable from +1V to +15V into 50Ω.

Max. current 300 mA

Source Impedance: Voltage source with about 300Ω or 50Ω termination

Polarity: Positive

Modes of Operation: Normal or complementary

Baseline Offset: Continuously variable from 0 to +2V Max. offset current 80 mA. Only the baseline is shifted.

Ramp Time: ≤10 ns at 5V and lower amplitudes with 50Ω internal or external termination. Typically 10 ns at 10V and 15 ns at 15V. (Typical rise time 6 ns).

Waveform Aberration: Less than ±5% between 3V and 15V into 50Ω and base line offset 0V.

Protection: Short and open circuit safe

TTL Pulse Outputs

Repetition Rate: 0.1 Hz...10 MHz variable in 8 ranges with continuous control within the ranges. Jitter less than 0.1%

Duration: 50 ns to 500 ms variable in 7 ranges with continuous control within the ranges. Jitter less than 0.1%

Duty factor approaching 100% using complementary pulse. More than 50% in normal operation.

Delay: In square wave mode the positive edge of the TTL complementary is delayed from the main complementary pulse. The delay time is the set duration subtracted from half the repetition time.

Amplitude: TTL level. Fan out 30 gates. About 4.5V open circuit

Polarity: Positive

Modes of Operation: Normal and complementary

Ramp Time: About 10 ns

Waveform Aberration: Less than 5% into 50Ω

Protection: Short and open circuit safe

Pulse Output: 50Ω TTL linedriver with filter for waveform correction, designed for 50Ω load

PM 5705

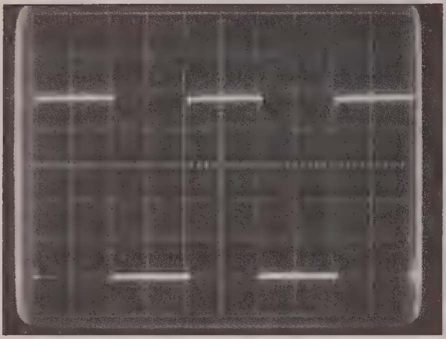


Fig. 1. Squarewave at 5 MHz

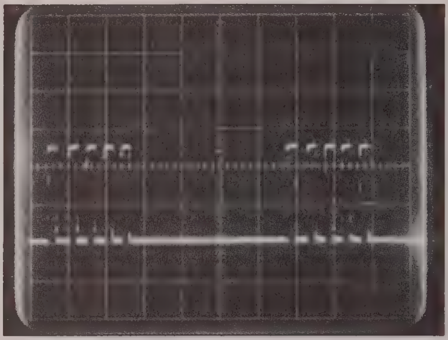


Fig. 2. Gated pulses

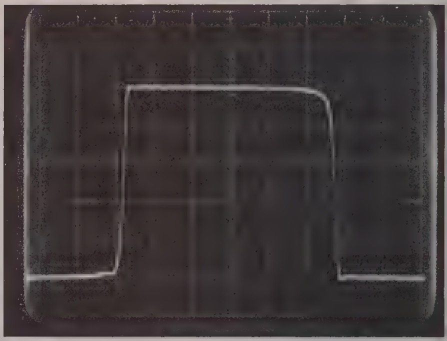


Fig. 3. TTL output

General Specifications

External Triggering and Gating

Level: > + 1V to trigger or gate the generator. Max. ±20V
Slope Selection: Positive or Negative slope
Frequency: 0...10 MHz
Input Impedance: Approx. 1 kΩ
Gating signal turns the generator 'off'. First pulse coincides with trailing edge of gating pulse.
Pulse Shaping: In square wave mode with repetition time set to external the frequency and duration of the output pulse are determined by the trigger pulses.
Single Shot: Single shot facility by means of push button. In square wave mode the TTL pulse duration is determined by the time the push button single shot is depressed.
Manual Gating: Depressing the single shot push button inhibits pulses when the generator is internally triggered.
Temp. Range: 0...40°C

Power Requirements

Line Voltage: 90...110, 100...130, 180...210 and 200...260V solderable
Frequency: 50...400 Hz
Consumption: 40 VA
Size: 210 mm W x 130 mm H x 275 mm L (8.3 in W x 5 in H x 10.8 in L)
Weight: 3.5 kg (7.7 lb)
Included with instrument: 1 line cable, 1 instruction manual

Ordering Information

Model	January 1989 prices
PM 5705/04 Pulse Generator	$940

Accessories (Also see page 485)

PM 9581/01 50Ω Termination (3W)	65
PM 9584/02 50Ω Mixing Piece	52
PM 9585/01 50Ω Termination (1W)	30
PM 9588/01 Coaxial Cable Set	265

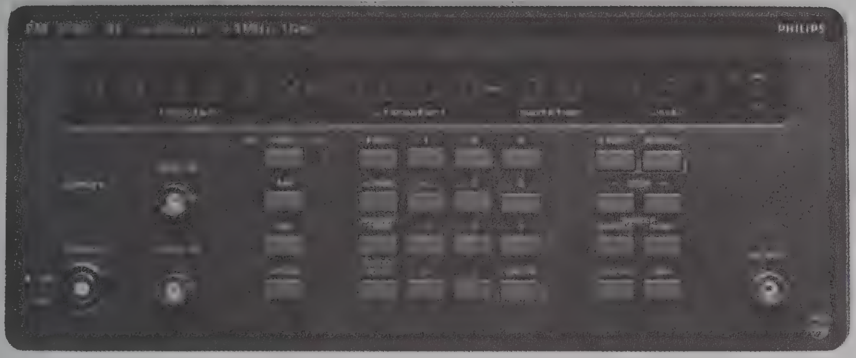
Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5390 & PM 5390S



PM 5390

PM 5390/90S Programmable RF Generator with Video Modulation

- Frequency range 100 kHz...1019.99 MHz
- Built-in GPIB/IEEE-488 interface with remote control LED indication
- Inputs for external AM and FM wideband modulation and external video source
- Push-button controlled video sound and carrier modulation
- Push-button selection of frequency, Δ frequency, sweep time, level and Δ level
- Step function settings for frequency/level, increment/decrement sweep facilities
- Keyboard facilitates swift and accurate entry or all digital parameters
- Output levels from -127 dBm to -7 dBm (PM 5390) or to +13 dBm (PM 5390S)

The PM 5390 and PM 5390S, operating beyond 1 GHz, will find wide application in the generation of carrier and subcarrier frequencies for TV, radio and communications, in sensitivity tests and radiation measurements.

Sweep measurements on broadband amplifiers and IF filters, plus signal simulation such as gain/bandwidth and conversion loss or antenna gain, can easily be accommodated.

It will be of especial interest for applications associated with cable TV bands, currently increasing UHF ranges and (ultimately) satellite TV. Moreover, the trend towards using programmable generators in automated testing systems, further extends its application potential.

The PM 5390/90S is a fully-programmable 1 GHz RF generator and provides AM, FM and video modulation, plus a wide range of sweep measurements and both automatic and manual frequency-stepping facilities. The output (100 kHz to 1020 MHz) is highly stable and accurate, and frequency, signal amplitude, frequency increment and sweep time can be digitally selected and displayed.

The heart of the PM 5390/90S is the main RF oscillator which is used for mixing frequencies generated by voltage controlled oscillators (VCOs) under phase-locked loop control. A 5 MHz crystal oscillator provides a highly stable reference source.

The main oscillator comprises four separate voltage-controlled oscillators (VCOs) from which six discrete frequency bands are produced. Two of these are developed within the main oscillator by a frequency-mixing process. The generated bands cover the ranges 340 to 510 MHz, 510 to 680 MHz, 680 to 850 MHz and 850 to 1020 MHz. Fig. 1 shows a block schematic of this circuitry.

Frequency control is achieved by comparing the output signal from VCO1 mixed with the relevant frequency generated by oscillator VCO2 to a signal from the reference oscillator.

Signals Divided Down

Both signals are divided down to 1 kHz (the reference signal) by a fixed reference divider and the output signal by a programmable divider controlled by the microprocessor. A phase detector ensures that the signals agree in both phase and frequency.

The output from the main oscillator is then fed out to an automatic level control. Amplitude modulation can be added after this stage. Video modulation is also applied here. The final section provides fine and coarse attenuation.

The lower two frequency bands are obtained by mixing the output of the main oscillator with the 510 MHz output of oscillator VCO3. Frequency modulation is applied to this oscillator to ensure constant deviation at different output frequencies.

Standard integrated circuits are used in the phase-locked loop control system. These were developed initially for similar applications in television and broadcast work. These LSIs are designed for use in microprocessor circuits and need few peripheral components.

Careful Attention to Shielding

Particular care has been taken to ensure negligible RF interference. The RF circuitry is split into two separately shielded sections — oscillators in one part and the digital control circuitry in the other — to reduce any possible crosstalk.

As the accuracy of the output frequency is directly related to that of the crystal-controlled reference oscillator, this is contained in a specially shielded compartment in the control box. The circuitry is designed to ensure stability of better than 1 part in 10^{-6}.

Built-In Microprocessor

The built-in microprocessor enables simple and rapid selection of parameters and values via front-panel-mounted push-buttons, and permits the storage of up to 8 sets of parameters for subsequent use. All values are clearly displayed on four separate LED displays. Full remote control is assured via the integral GPIB/IEEE*/IEC interface.

Internal and external AM and FM modulation are important features.

** The terms GPIB an IEEE-488 may be used interchangeably throughout this catalog.*

PM 5390 & PM 5390S

Modulation

AM modulation is effective over the full 1 GHz range, FM modulation is up to 340 MHz.

Video modulation facilities are possible over the full video band with the choice of internal or external AM or FM sound. This makes the instrument an invaluable tool in, for example, video equipment production testing.

Internal or External Sweep

Single and continuous sweep modes can both be internally or externally controlled; sweep time can be varied from 0.05 to 20 seconds. Manual or automatic incremental frequency-changing is also provided in the range 1 kHz to 50 MHz, positive or negative. This latter facility is ideal for random sequence testing of TV and/or radio channels.

Extremely Wide Application Potential

The PM 5390/90S is thus designed to cater to almost every possible application in industrial electronics including audio, video and communications. As such, it meets today's need for a versatile, easy-to-use RF signal source having the most comprehensive modulation facilities; with reserve performance for tomorrow.

Specifications

Technical Specifications

Frequency

Frequency Range: 100 kHz...1019.99 MHz
Setting: Keyboard, IEEE/IEC bus
Display: 6-digits LED display
Resolution: 0.1-1000 MHz - 1 kHz; ≥1 GHz - 10 kHz
Setting Error: after 30 min.- 3 x 10^{-6}; after 80 min. - 1 x 10^{-6}

Reference Oscillator

Temperature Effect: ≤1 x 10^{-6}/K
Crystal Aging: ≤1 x 10^{-6}/month

Spectral Purity

	Range	PM 5390S	PM 5390
Harmonics	≤7 dBm	<-30 dB typ.-35 dB	<30dB typ.-35 dB
	to 0 dBm	-30 dB	
	to + 7 dBm	<-25 dB	
	to + 13 dBm	-20 dB	
Non-Harmonics	≥340 MHz	<-40 dB	typ.<-45 dB
	<340 MHz		<-30 dB
Residual FM r.m.s. 0.3-3 kHz (typical)	75 Hz 40 Hz in sub-ranges	75 Hz 40 Hz in sub-ranges	75 Hz 40 Hz in sub-ranges
SSB phase noise distance 20 kHz	-100 dBc/Hz	-100 dBc/Hz	-100 dBc/Hz
Residual AM	typ.<0.5%	typ.<0.5%	typ.<0.5%

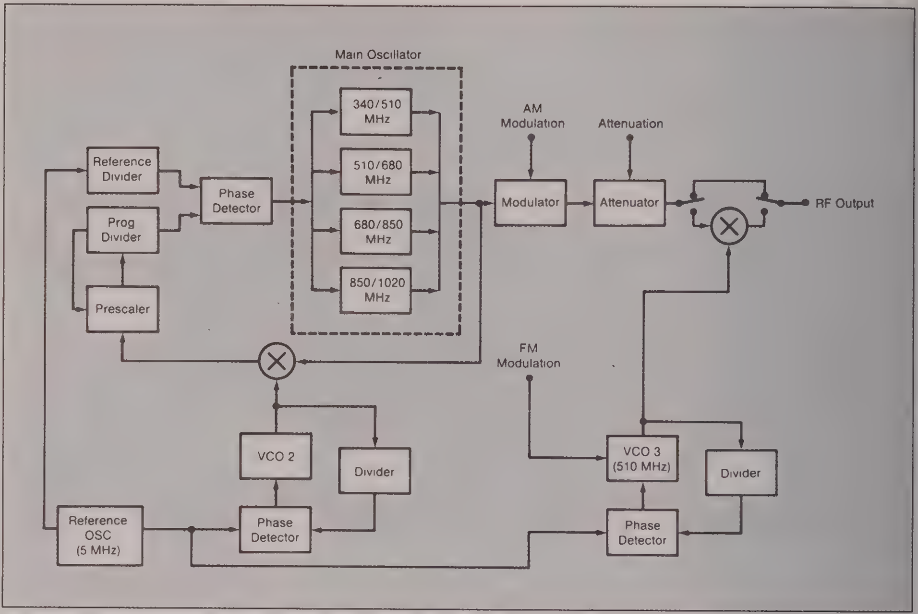
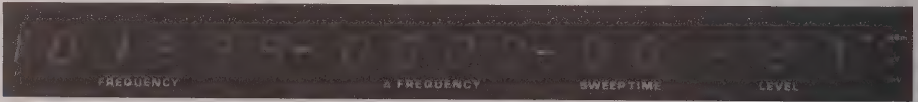
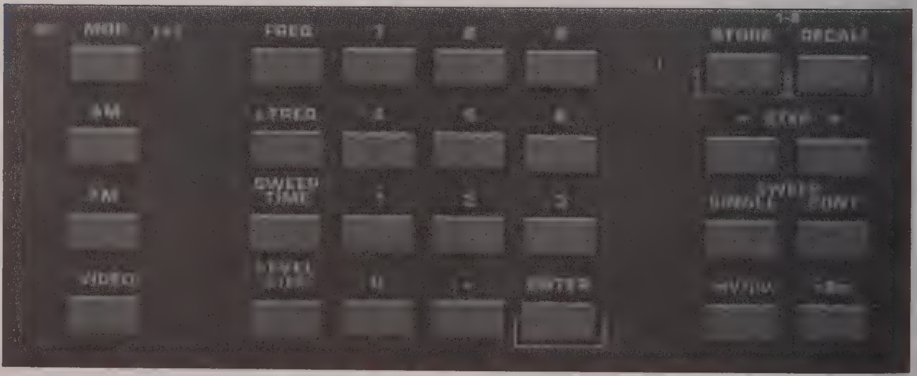


Fig. 1. The PM 5390/90S RF synthesizer functions by mixing frequencies from several oscillators derived from a 5 MHz crystal source.



Detail of the LED panel. The display is subdivided into four parts: 6 digits for the selected RF frequency, (-)4 digits for the incremental frequency, 2 digits for sweep time and 21/2 digits plus polarity indication for the output level.



Detailed view of control panel.

Frequency Increment (Δ FREQUENCY)

Frequency Range: 100 kHz...1019.99 MHz
Increment Range I: 1 kHz...9.999 MHz resolution - 1 kHz
Increment Range II: 10.00...99.99 MHz resolution - 10 kHz
Setting: keyboard, IEEE/IEC bus
Settling Time per Increment: 80...240 ms
Indication: 4 digits, LED

Output Characteristics

RF. Output
Impedance: 50Ω
Output Level (into 50Ω):
PM 5390: -127 dBm to -7 dBm;
PM 5390S: -127 dBm to +13 dBm.
Output Voltage rms (into 50Ω): 0.1 µV...100 mV; 0.1µ...1V
Setting: keyboard, IEEE/IEC bus
Display: 2-1/2 digits, LED
Dimension: dBm, µV, mV, V
Resolution: 1 dB

PM 5390 & PM 5390S

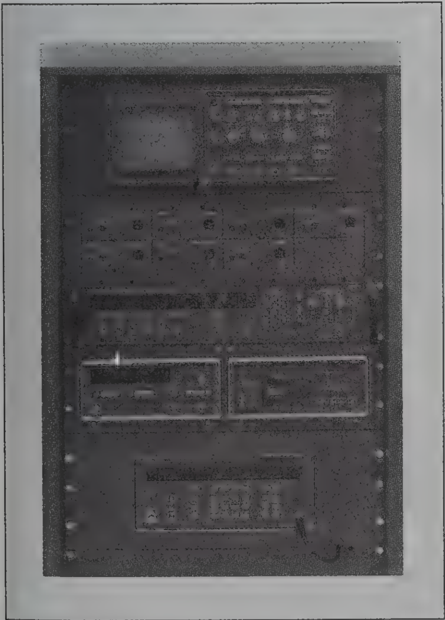
Level Accuracy	PM 5390(S)	Output level
Frequency response 100 kHz-1020 MHz	±2 dB ±1.5 dB typical	measured at maximum output level
Flatness		
in frequency sub-ranges III, IV, V, VI	0.8 dB	
in frequency sub-ranges I, II	±1 dB	

Attenuation Error per 1 dB step: ±0.3 dB
Additional: ±0.3 dB, ±0.5 dB
Connection: BNC output socket
Load: Short-circuit proof
Max. External Voltage: ±3.5V

Modulation

Modulation Modes: Frequency range
RF Carrier Unmodulated: 100 kHz...1019.99 MHz
Amplitude Modulation, AM: 100 kHz...1019.99 MHz
Frequency Modulation, FM: <340 MHz
Video without Sound Carrier: >30 MHz
Video Sound Carrier AM int/ext.: >30 MHz
Video Sound Carrier FM int/ext.: >30 MHz

Amplitude Modulation, Internal
Modulated Frequency Range: 100 kHz... 1019.99 MHz
RF level reduces by 6 dB



PM 5390 operating within an automatic testing set up.

Modulation Frequency: 1 kHz, sine wave
Modulation Depth: 30%
Accuracy: ≤5%
Setting: keyboard, IEEE/IEC bus
Indication: LEDs

Amplitude Modulation, External
Modulated Frequency Range: 100 kHz... 1019.99 MHz
RF level reduces by 6 dB
Modulation Frequency: 20 Hz...20 kHz
Modulation Depth: 0-≥80%
Modulation Coefficient: 10 mVp-p/%
Connection: BNC socket
input impedance: 10 kΩ
max. external voltage: ±5V
Setting: keyboard, IEEE/IEC bus
Indication: LEDs

Frequency Modulation, Internal
Modulated Frequency Range: 100 kHz... 339.999 MHz
Modulation Frequency: 1 kHz, sinewave
Deviation: ±25 kHz

Frequency Modulation, External
Bandwidth: 20 Hz...100 kHz
Max. Deviation: ±80 kHz (5...339.999 MHz); ≤± 10 kHz (0.1 MHz-<5 MHz)
Modulation Coefficient: 100 mV/7.5 kHz
Connection: BNC socket
input impedance: 10 kΩ
max. external voltage: ±5V
Setting: keyboard, IEEE/IEC bus
Indication: LEDs

Video

Modulated Frequency Range: 30...1019.99 MHz
Bandwidth: 8 MHz
Amplitude ext. CVBS-Signal: 1 Vp-p into 75Ω
polarity: negative sync. signal
modulation: negative (or positive)
Residual RF Carrier: 15%
Connection: BNC socket
input impedance: 75Ω
max. external voltage: ±5V
Setting: keyboard, IEEE/IEC bus
Indication: LED

Sound

Sound Carrier Internal
Spacing of Vision/Sound Carrier: 5.5 MHz (4.5; 6; 6.5 MHz)
tolerance: <0.2%
Vision/Sound Carrier Ratio: 13 dB
Type of Modulation: FM or AM

Internal Sound Modulation
Modulation Frequency: 1 kHz, sine wave
Deviation: ±40 kHz FM mode
Modulation Depth: 30% AM mode
Setting: keyboard, IEEE/IEC bus
Indication: LEDs

External Sound Modulation
Bandwidth: 50 Hz...20 kHz
Pre-Emphasis: 50µs
Modulation Coefficient FM: 100 mVp-p/8 kHz
Max. Deviation: ±75 kHz
Modulation Coefficient AM: 100 mVp-p/6%
Max. Modulation Depth: 50%
Connection: BNC socket
input impedance: 0.5 MΩ
max. external voltage: ±5V

Indication: LEDs
Setting: keyboard, IEEE/IEC bus
Frequency Sweep: Within a selectable sweep time the frequency passes through a selectable range Δ FREQUENCY in 50 steps from the start frequency (FREQUENCY) to the stop frequency (FREQUENCY + Δ FREQUENCY)
During fly-back the amplitude is reduced.
Frequency Range: 100 kHz...1019.99 MHz
subrange I: 0.1 MHz...169.999 MHz
subrange II: 170 MHz...339.999 MHz
subrange III: 340 MHz...509.999 MHz
subrange IV: 510 MHz...679.999 MHz
subrange V: 680 MHz...849.999 MHz
subrange VI: 850 MHz...1019.99 MHz
Sweep Width: 50 kHz...50 MHz
Step Width: 1 kHz...1 MHz
Number of Frequency Increments per Sweep: 50
Setting: keyboard, IEEE/IEC bus
Indication: 4 digits

Sweep Modes

Single Sweep: Indication - LED
Continuous Sweep: Indication - LED
Sweep Time: 50 ms...20s
resolution: 0.01s...1s
setting: keyboard, IEEE/IEC bus
indication: 2 digits, LED
Flyback Time: 200 ms
Output-Sweep Voltage:

Sweep Time Out

Amplitude: 50 steps of 10 mV each
Impedance: 10 kΩ
Max. External Voltage: ±10V

Storage of Parameter Setting
Memory Locations: 8 complete parameter settings
Storage: Buttons STORE 1...8
Store Time: min. 5 days
Battery: NiCd-cell
Setting: keyboard, IEEE/IEC bus

Remote Control
Conformity: IEEE 488/IEC 625
Connection: 24-pole IEEE bus standard interface
Device Address: Address switch rear side
Remote Indication: LED, remote, front panel
Interface Functions:
AH1 acceptor handshake capabilities
L1 Listener only
RL2 Remote/Local capability
DC1 Device clear capability
Delimiters: Comma, LF (NL + New Line) EXT, ETB
Control Functions: Fully remote controllable

Settling Time
Interface Reaction Time: 2...20 ms typical 5 msec
Frequency Settling Time: 15...120 ms
Level Settling Time: 5 ms

PM 5390 & PM 5390S

General Specifications

Power Requirements

Reference Value: 220V
Nominal Values: 110V/128V/220V/238V, selectable by wiring
Nominal Operating Range: ±10% of selected nominal value
Operating Limits: ±10% of selected nominal value
Nominal Frequency Range: 50/60 Hz tolerance: ±5% of nominal frequency range
Power Consumption: 44W/53W

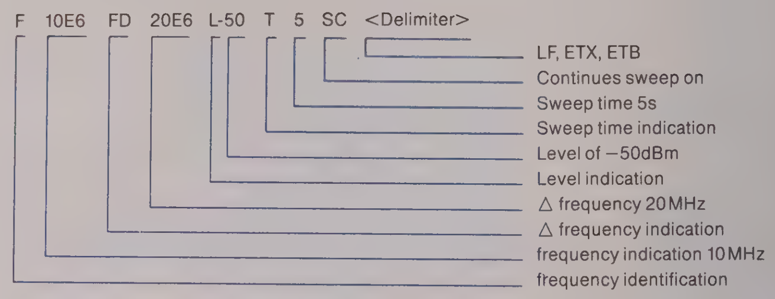
Environmental Capabilities

Ambient Temperature:
Reference Value: +23°C ±1K
Nominal Working Range: +5°C...+40°C
Limits for Storage & Transport: -40°C...+70°C

Cabinet
Protection Type (see DIN 40050): IP 20
Protection Class (see IEC 348): Class I, protective conductor
Line Connection: Mains connector; Shielding; RF-unit double screened
Size: 310 mm W x 140 mm H x 660 mm L (12.2 in W x 5.5 in H x 26 in L)
Weight: 9.9 kg (22 lb)

Included With instrument: Operating manual, power cable (2 meters)

PROGRAMMING EXAMPLE



Ordering Information

Models

January 1989 prices

PM 5390M Programmable 1 GHz RF Generator (-7 dBm output)	$6950
PM 5390SM Programmable 1 GHz RF Generator (+13 dBm output)	7450

Accessories (Also see page 485)

PM 9075 Coaxial Cable BNC-BNC	$11
PM 9585 50Ω Termination, 1W	30
PM 2295/10 IEEE Bus Cable (1meter)	155
PM 2295/20 IEEE Bus Cable (2 meters)	$170
PM 2296/50 IEEE/IEC Adapter	70
PM 2296/60 IEC/IEEE Adapter	80
PM 9560 19-in Rackmount Adapter	130

Service & Support

Warranty

One-year product warranty. (See page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5326

PM 5326 Video RF Signal Generator

- 100 kHz to 125 MHz in 9 overlapping ranges
- 5-digit counter displays, RF-carrier marker and external frequencies to 10^{4} ±1 digit
- 50 mV RF output at 75Ω can be attenuated to over 100 dB
- Output level electronically stabilized
- Sweep facility for IF amplifiers AM/FM, radio and TV receivers

The RF signal generator PM 5326 has been specially designed for radio and television development laboratories and those involved with receiver sensitivity and selectivity measurements. For service workshops and education the generator also provides four sweep ranges for the alignment of IF amplifiers and FM receivers.

Color Coded Controls

The generator is divided into three functions: main RF oscillator; sweeper; and marker generator. Controls for each function are differently color-coded, being grouped for operator convenience.

Main RF Oscillator

The output frequency extends from 100 kHz to 125 MHz in 9 push-button selected ranges amply covering the domestic AM/FM radio spectrum. A built-in 5-digit display enables frequencies to be easily set to 1 part in 10000, essential for precise alignment procedures, selectivity and filter tests. This counter can also measure frequencies from external oscillators to 999.99 kHz, extendable to 99.999 MHz. Typical uses for the counter include alignment of TV remote control units and checking line and frame time base frequencies.

The output level is electronically stabilized for all ranges eliminating resetting and the need for meter reading and can be continuously attenuated to over 80 dB from the maximum of 50 mV into 75Ω.

This may be set to levels calibrated at -3 dB and -40 dB with a separate attenuator. A particular feature of the generator is the special attention given to spurious RF radiation. A 'double-box' construction gives a high degree of screening, keeping RF radiation very low and ensuring that low level outputs in the region of 0.5 µV can be used with full confidence.

AM/FM Modulation

A choice of CW or MCW output AM or FM and internal or external modulation signals are quickly selected by push-buttons. All AM signals can be internally modulated by a 1 kHz tone to a depth of 30% which is adequate for most applications. This can be increased to 100% over the range 20 Hz to 20 kHz (3 dB) by an external source. Frequency modulation may be applied to the 10/11 MHz and 75-110 MHz ranges allowing complete alignment checks to be made on FM receivers. Internal frequency modulation at 1 kHz is equivalent to a 22.5 kHz deviation. External signals can be applied to a maximum deviation of 75 kHz over the frequency range 20 Hz to 60 kHz (3 dB).

A swept frequency oscillator output is available to measure the dynamic response of intermediate frequency amplifiers in AM/FM and TV receivers. Four frequency ranges are selectable by push-buttons. The maximum sweep widths are 40 kHz for AM/IF, 1.2 MHz for FM/IF and Band II and up to 10 MHz for the video IF ranges. Sweep rate is either by a linear sawtooth between 3-30 Hz or at a line frequency with phase adjustment.

Marker Generator

Markers are available in each RF sweep range to indicate a precise frequency value and provide a calibrated frequency scale over the complete spectrum. The position of the variable marker is controlled by the main frequency control and the setting is displayed on the internal counter. Fixed markers at regular intervals may be added to the output signal by pulling the marker amplitude switch.

Specifications

Technical Specifications

Frequency

Range: 100 kHz...125 MHz
(9 subranges, selectable with push-buttons)
Subranges:

1. 100 kHz...250 kHz
2. 250 kHz...500 kHz
3. 500 kHz...1000 kHz
4. 1 MHz...2.5 MHz
5. 2.5 MHz...5 MHz
6. 5 MHz...10 MHz
7. 10 MHz...25 MHz
8. 25 MHz...50 MHz
9. 50 MHz...125 MHz

Display: 5-digits, 7-segment 11 mm LED, 2-dimension LEDs kHz, MHz
Setting Error: <10^{-4} ±1 digit (typical)
Temperature Coefficient: <10^{-5}/K
Short Term Drift: 1 x 10^{-6}

RF Output

Voltage: 50 mV at 75Ω
Impedance: 75Ω
Frequency Response: <2 dB in each RF range (1 dB typical)
Attenuation:
80 dB continuous with indication
40 dB and 3 dB calibrated and switchable

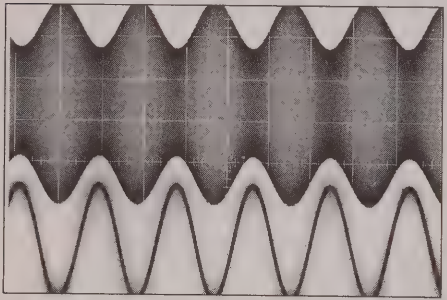
PM 5326

Modulation

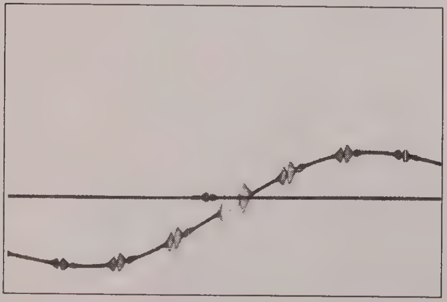
Amplitude Modulation: (in all ranges)
Unmodulated
Internal with 1 kHz sinewave (depth 30%)
External with signals 20 Hz...20 kHz (3 dB) (depth 0...100%)
Modulation Coefficient: 200 mV/10% modulation depth
Frequency Modulation:
In ranges 10...11 MHz and 75...110 MHz
Unmodulated
Internal with 1 kHz sinewave (deviation 22.5 kHz)
External with signals 20 Hz...60 kHz (3 dB) (deviation 0...±75 kHz)
Modulation Coefficient: 200 mV/±7.5 kHz deviation
Input: BNC connector MOD/IN
Impedance: >10 kΩ
RF Sweep Ranges:
400 kHz...500 kHz
10 MHz...11 MHz
75 MHz...110 MHz
36 MHz...41 MHz
Frequency Response: >0.2 dB in sweep ranges
Sweep Frequency: 3...30 Hz continuously variable;
50 Hz or 60 Hz mains, phase variable
Sweep Widths: (fully variable)
0...4 kHz in range 400 kHz...500 kHz
0...1.2 MHz in range 10 MHz...11 MHz
0...1.2 MHz in range 75 MHz...110 MHz
0...10 MHz in range 36 MHz...41 MHz
Linearity: >95%
Center Frequency: Fully adjustable between minimum and maximum
Output: BNC connector Sweep out
Voltage: 2...10 Vp-p (varied by internal sweep)
2V at 1 kHz at AM or FM (internal)
Impedance: 1 kΩ

Marker Generator

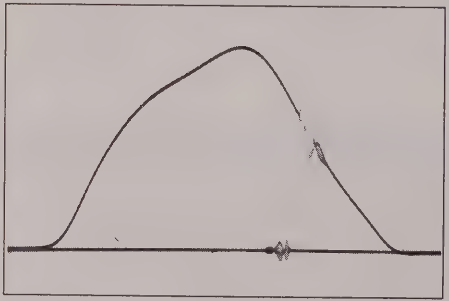
Fully variable over all four RF sweep ranges and indicated by LED display.
Marker: Marker mixing, AF beat frequency markers
Amplitude: Adjustable to 2 Vp-p
Output: Marker addition via loop through BNC connections Y_{in} - Y_{out}
Impedance: >500 kΩ



Internal AM signal, 1 kHz and 30% modulation depth at a carrier frequency of 27 MHz.



S curve with variable marker at 10.7 MHz and fixed markers at regular intervals of 100 kHz.



The luminance IF curve is aligned at its frequency of 38.9 MHz.

Fixed Markers

Obtained by pulling marker amplitude switch. Distance between the fixed markers dependent on selected range.

Counter (PM 5326X only)

Selected by COUNTER EXT push-button
Input: BNC-connector
Frequency Range: 10 Hz - 999.99 kHz
Input Voltage: 30 mV...50V
Input Impedance: 1 MΩ

General Specifications

Power Requirements

Voltage: 115, 230V
Power Consumption: 18W
Frequency: 48...63 Hz
Size: 310 mm W x 140 mm H x 330 mm L (12.6 in W x 5.5 in H x 13 in L)
Weight: 6.5 kg (14.3 lb)
Included: PM 9537 Cable with impedance transformer 75/300Ω, operating/service manual, line cord.

Ordering Information

Models

January 1989 prices

PM 5326 RF Signal Generator	$2470
PM 5326X As PM 5326 with a counter facility up to 100 MHz	2640

Accessories (Also see page 485)

PM 9072 Cable BNC 4 mm	28
PM 9075 Cable BNC-BNC	11
PM 9560 19-in Rackmount Adapter	130

Service & Support

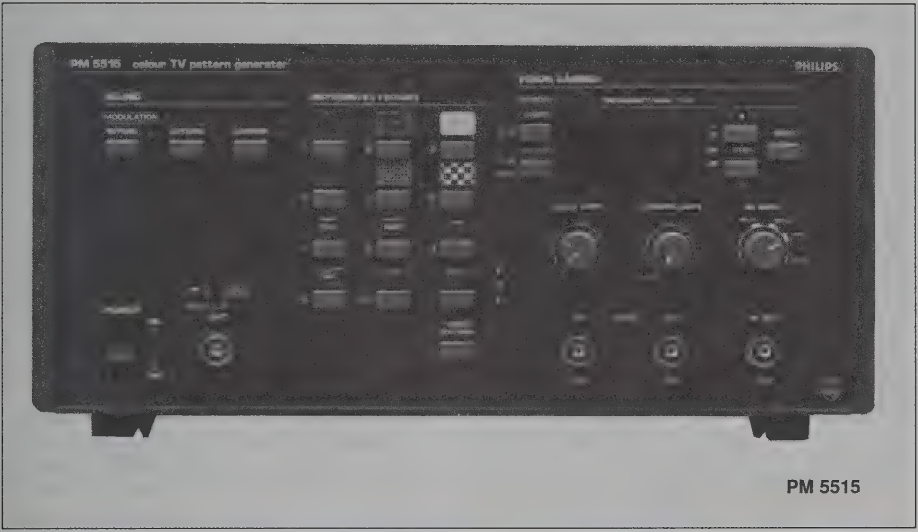
Warranty

One-year product warranty. See Page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

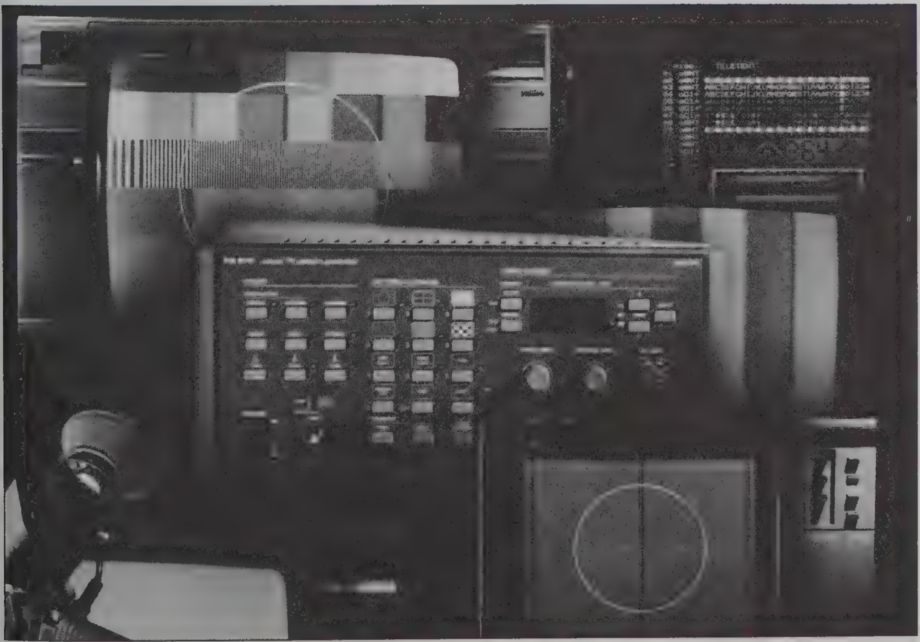
PM 5515, PM 5516 & PM 5518

GPIB IEEE-488



PM 5515

PM 5515/16/18 Color TV Pattern Generator Family
Synthesized control of RF frequency
Covering every RF band from IF to bands IV/V including cable TV bands
Storage and recall of 10 complete programs, RF freq., pattern and sound settings
Keyboard call-up of up to 70 test patterns/combinations
Simple TV standard selection of PAL, NTSC or SECAM
Operation of up to 3 to 4 receivers on a 10 mV output
RGB option
GPIB/IEEE-488 version with standard RGB and universal chroma



A Pattern for the Future

This family of versatile color pattern generators is designed to cover all available TV standards.

- PM 5515 is for PAL/NTSC
- PM 5516 is for SECAM
- PM 5518 is for SECAM/PAL/NTSC

All models are microcomputer-controlled with powerful, non-volatile memories, allowing predetermined user-programs to be stored and recalled at will. At the touch of a key.

Over 70 different patterns and combinations are achievable, as well as Teletext, FM stereo and dual-channel sound. All very simple to set up.

Each model in the series is available in a basic configuration, and also with enhanced versions to cater to the widest possible spectrum of applications. These are listed at the end of this section. For servicing of color TV monitors and applications involving computer graphics, an RGB option is available. A system version, the TXI, with GPIB/IEEE-488* interface built-in, RGB, and universal chroma as standard, is also available.

Thus many of today's video testing problems are well covered, with reserve capability ready for tomorrow's needs.

Versatility with Ease

The PM 5515/16/18 series offers you unparallelled versatility and ease of use.

Thanks to microcomputer control, one simply keys-in the programs required — R.F. frequency setting, pattern selection and sound modulation. Touch a button to store them — ready for recall. And, even a year later, just recall and the program is still there — ready for immediate use. Versatility plus simplicity.

Lowest Cost of Ownership

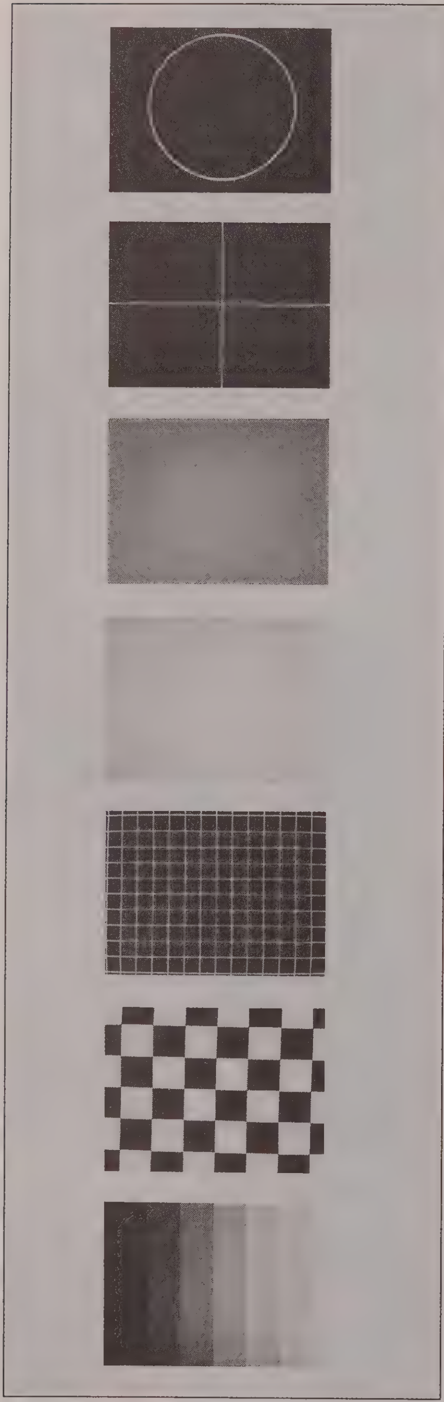
Microprocessor control offers more than versatility with ease. It offers security and reliability. Software modules and solid-state memories take over from mechanical switches, reducing service and maintenance costs to the absolute minimum. And with Philips built-in quality and reliability the user enjoys a sound guarantee of low cost of ownership.

An Unparallelled Range

The PM 5515/16/18 series offers an unparallelled range of pattern generators. From the versatile basic model with its touch-button control of every parameter, through models offering FM-stereo and dual sound or Teletext test and page signals, up to the model that offers everything! A range from which one can choose a pattern generator for today — knowing that it will meet tomorrow's needs.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 5515, PM 5516 & PM 5518



Patterns for Now and for the Future

Twelve push-buttons make the selection of eighteen different patterns possible. These test patterns check and align the monochrome and chrominance circuitry of the color TV monitors and VCR.

Circle on a grey background for checking the overall linearity and geometry. The white circle changes automatically to black when used with the white pattern and is useful for checking reflections.

Center Cross/Border lines is ideal for centering TV monitors and TV screens. Also to check the deflection linearity and for pin-cushion correction.

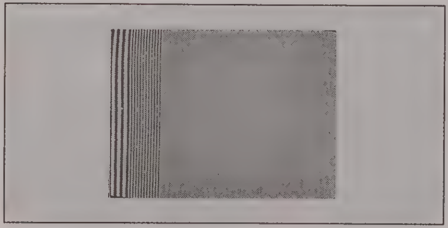
White 100% with swinging burst is designed for setting white D and for an overall check of purity. Also for beam current adjustment. White D is the correct white necessary for a natural color reproduction.

Dot pattern mainly for static convergence. The screen should contain pure white dots.

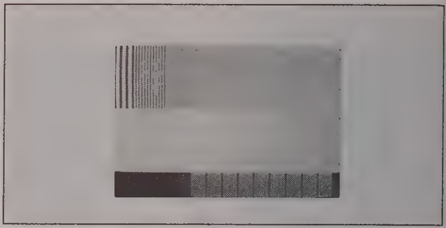
Cross hatch/Center Indication with 17 vertical and 12 horizontal lines is used for checking and re-aligning dynamic and corner convergence. The advantage is that there is no interlacing which would normally tire the eyes. If interlacing is required this can be achieved by superimposing another pattern such as center cross or circle.

Checkerboard pattern of six times eight rows of squares provides a visual standard for basic picture tube alignments, for example: centering, focus, horizontal and vertical deflection and linearity.

Grey scale. Full-screen linear staircase signal with 8 equal steps from black to white is used to locate faulty linearity of the video amplifier or grey-scale setting.



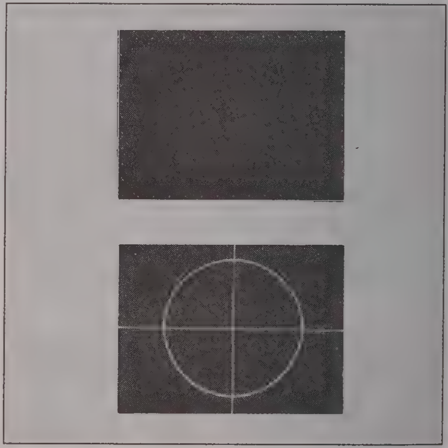
Multiburst contains eight full screen vertical bars of defiinition lines in the frequency ranges 0.8, 1.8, 2.8, 3.0, 3.2, 3.4, 3.8 and 4.8 MHz. This checks the bandwidth of the video or luminance amplifier in black and white or color TV as well as the resolution of monitors and video recorders.



VCR is a specially-designed test pattern to check the bandwidth, linearity, sensitivity and AGC of the chroma amplifiers in color video recorders.

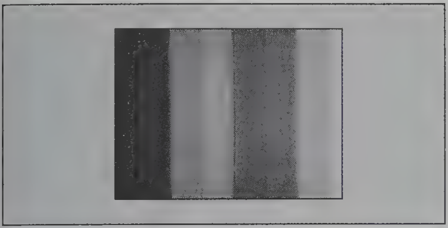
This combined test pattern is divided into 4 horizontal segments:

- 24 lines of 100% white to clip and to level.
- Eight bars of resolution of which 2.8 - 3.0 - 3.2 - 3.4 MHz are used to align the high-pass filter for a maximum resolution in VCR bandwidth.
- Eight steps of decreasing linear levels of saturation from 100 to 0% to check the chroma amplifier linearity and color AGC circuitry.
- A black horizontal bar with a moving white field to check moving pictures on video recorders.



Purity with a choice of the three primary colors clearly indicated by LEDs. The red pattern is used for checking color purity. The green pattern provides a purity check for three-in-line tubes. Blue is also available to check color performance. The three complementary colors, magenta, yellow and cyan can also be displayed by selection, as can white and black.

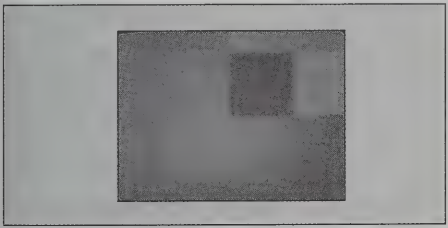
Combinations with circle and/or center cross are easy to select.



Color bar standard bar pattern. The vertical bars are white D, yellow, cyan, green, magenta, red, blue and black.

Since it is dependent on the TV system selected, the luminance content is automatically corrected for each setting.

The color bar pattern therefore provides sufficient information for a good overall check of color performance, including checks on burst keying, subcarrier regeneration, RGB amplifiers, the delay color versus B/W signal and saturation.



Examples of PAL coded DEM pattern. For NTSC this DEM pattern contains different color coding.

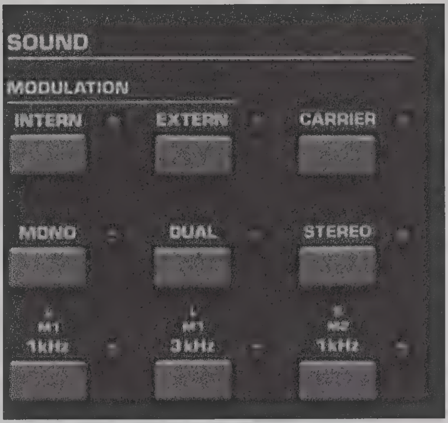
G - Y = 0		Y = 50%	
Δ + (R - Y)	Δ - (R - Y)	◊ + (B - Y)	◊* - (B - Y)
Δ ± (R - Y)	Δ ± (R - Y)	◊ ± (B - Y)	◊** ± (B - Y)
Reference Y = 50%			

Δ (B - Y) = 0 ◊ (R - Y) = 0

* *PAL coded*

** *Anti-PAL coded*

DEM pattern. Demodulator is a combined test pattern which, divided in 4 sections, contains information to make on-screen checks and alignments of the color demodulators and sub-carrier frequency. For PAL it is used to check the chroma delay line for amplitude and phase (venetian blinds). For the NTSC system, the pattern is according to the NTSC requirements and contains 7 color bars, -I and +Q signals and a black and white reference field.



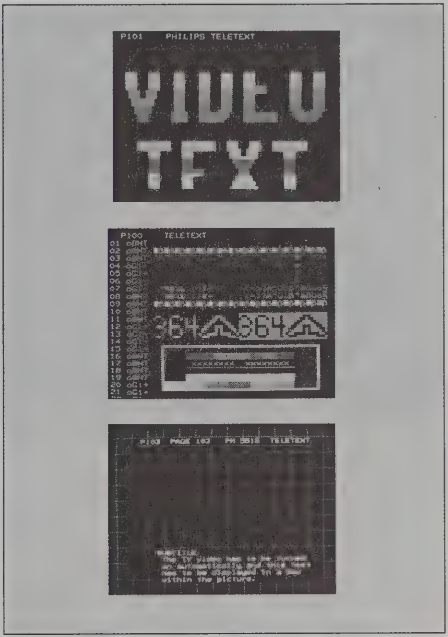
Stereo and Second Sound Channel

For use in standard CCIR, PAL G systems, the PM 5515/16/18 have a selection of optional -X, -TX, and TXS configuarations with two sound carriers — for use in one- and two-channel mode, or right and left channel of a stereo signal. They are therefore appropriate for European systems (and are not compatible with MTS (NTSC) stereo systems).

CTV transmission with stereo sound or alternative second sound channel (e.g. to choose between synchronized or original voice tracks) is becoming more common. The special CTV receivers with stereo decoders needed to reproduce these broadcasts can be expected to be increasingly popular. The -X, -TX and -TXS meet the need for a portable color pattern generator for test and realignment of these receivers.

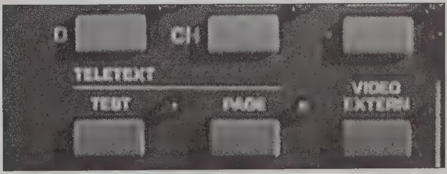
The instrument allows external modulation from a full stereo tuner/amplifier, tape or cassette recorder, with PM 5515 as the RF modulator.

- Sound carriers according to standard at 5.5 MHz and 5.742 187 5 MHz ±3 x 10^{-5}
- Sound/vision separation at 13 and 20 dB, respectively
- Internal FM of 1 kHz and 3 kHz with 30 kHz deviation
- Full external stereo modulation facility for all types of stereo equipment (recorders, CDs, tuners, etc.)
- Pilot tone according to standard at 54.687 5 kHz ±3 x 10^{-5}, with recognition frequencies at f_H/133+117.5 Hz (stereo) and f_H/57+274.1 Hz (second sound channel)



Teletext

The growth of electronic communications has seen a rapid increase in the introduction of text transmission. To meet the highly specialized requirements for the checking and alignment of teletext receivers and decoders in PAL G and I systems the -T, -TX, and -TXS configurations have been specially developed. Both instruments offer the facility of a selection of five teletext pages with special contents for decoder testing as well as a wallpaper test pattern.



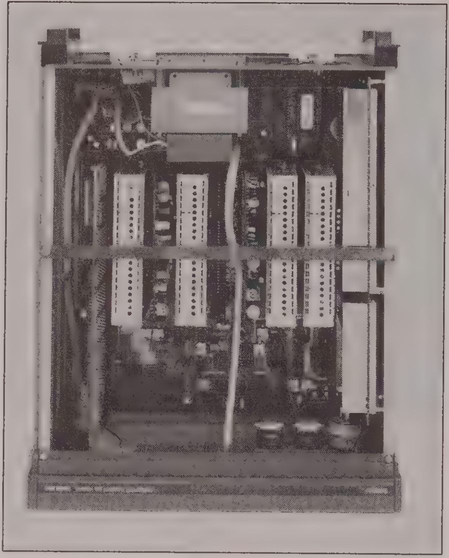
RF Selection

All models cover the full frequency range from 32...900 MHz, including IF and TV transmissions in frequency bands I, III, IV and V. Full coverage of cable TV and S-channels is provided in frequency bands 104...175 MHz (S1...S10) and 230...300 MHz (S11...S20); and hyperband coverage is provided in the frequency range 300...470 MHz. Selection of the synthesized RF frequency within these bands is electronic, via the keyboard.

Up to ten memory places can be used either to store the selected RF frequency or TV channel number. Having stored, e.g. the local TV stations, any one of them can be recalled at the touch of a button without time consuming dial tuning.

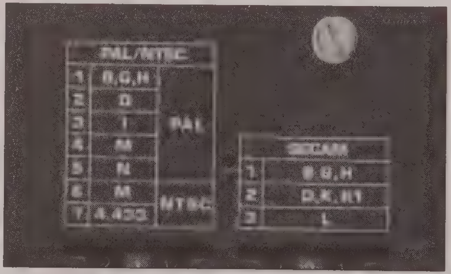
The first digit shows the memory place. The other three digits indicate the selected freq uency or TV channel. The RF carrier output of >10 mV into 75Ω is ample for 3 or 4 receivers in parallel during workshop repairs, and the carrier can be continuously attenuated by more than 60 dB, with output indications at 1 mV, 100 μV and 10 μV levels. The ability to smoothly vary the RF level is of particular value when checking the overall RF sensitivity or AGC circuits.

Up to ten memory places can be used either to store the selected RF frequency or TV channel number. Having stored, e.g. the local TV stations, any one of them can be recalled at the touch of a button without time consuming dial tuning.



RF Carrier and Frequency Spectrum

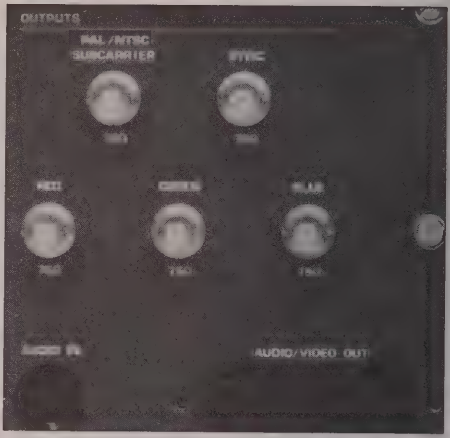
Although double sideband, the RF envelope of the PM 5515/16/18 is very similar to that transmitted by professional TV broadcast companies, such as, e.g., 13 dB for TV standard G between the sound and vision channels. (Most other generators have 25 dB or more separation, leading to false impressions when aligning tuners and RF amplifiers.)



The System Switch

The rear of the instrument offers additional facilities which add to the uniqueness of the PM 5515/16/18 range. A selection switch is used to choose the TV system required. Line frequency is automatically selected utilizing internal crystals, either 15 625 Hz for CCIR or 15 734 Hz for RTMA with less than 0.4 Hz frequency tolerance.

The correct crystal for color and subcarrier, determining line- and frame-frequencies, is selected automatically.



The Euro/SCART connector for audio/video out as well as the DIN connector for external audio modulation are standard for all models.

Outputs

On the rear panel, video output is via a Euro Scart connector an external sound modulation via a standard DIN plug. Color subcarrier and sync signal are supplied as standard, with RGB optionally available.

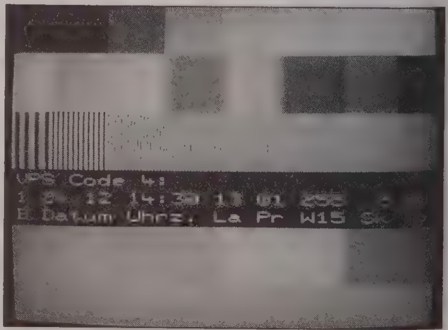
RGB Option

RGB signals and a SYNC and subcarrier facility are available to meet the rapid advance in computer graphics techniques and servicing of color video monitors. There are many monitors which only accept RGB signals and for testing these the RGB option is essential.

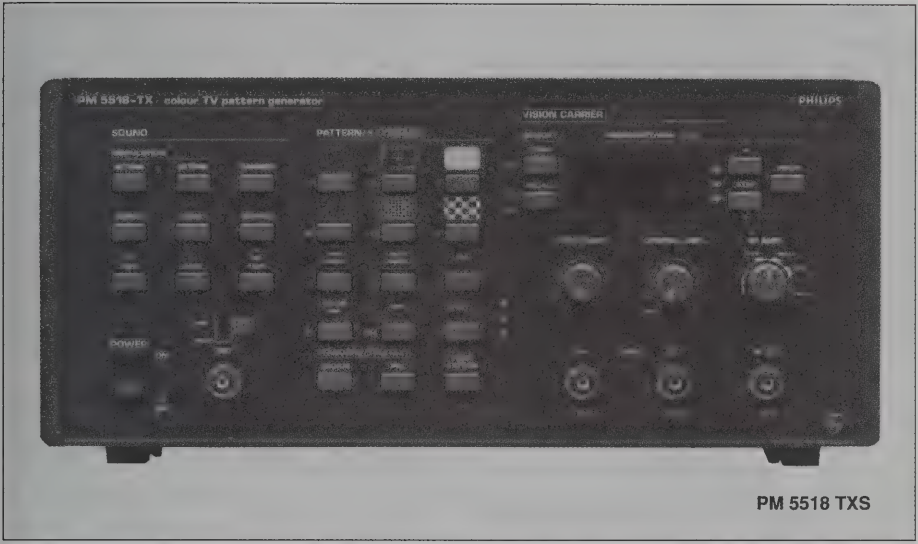
VPS Test Facilities

PM 5515-TXS and PM 5518-TXS models offer complete testing of video cassette recor- ders equipped with VPS, under the PAL B/G/H, D and I/N standards. A maximum of 9 coded VPS signals are available including date, transmission time, country indication, TV channel, stereo/dual/mono sound and adult/general suitability.

Special signals such as LEER code, program interrupt and system status can also be selected. VPS data is shown in a 1/6 screen height horizontal bar which can be combined with any test pattern and displayed in six positions, either on- or off-screen. Unique to VPS instruments is on-screen display of codes and programming the generator to set codes locally if required.



PM 5515, PM 5516 & PM 5518



PM 5518 TXS

A Range for Today and Tomorrow

The versatility of the Philips color pattern generator family not only ensures that today's requirements are expertly met but the developments of tomorrow are anticipated.

PM 5515 Generator For PAL/NTSC

The standard PM 5515 generator with its advanced features, unrivalled in the market place, is complemented by four enhanced models:

PM 5515-T has 5 Teletext pages plus a wallpaper test pattern for aligning and testing teletext receivers and decoders.

PM 5515-X features full additional FM stereo and dual sound channel facilities according to system G.

PM 5515-TX offers, in addition to all the facilities of the basic model, all those features provided by the other two models.

PM 5515-TXS further expands on the -TX version by adding VPS for PAL system G.

PM 5516 Generator For SECAM

The PM 5516 offers the same features as the standard PM 5515 above, except it operates according to the French SECAM TV system L with positive video modulation and AM sound. It also operates to the TV standards D, K1, B, G and H corresponding to OIRT TV system with negative video modulation and FM sound. The desired TV standard is simply selected at the rear of the instrument.

PM 5516 is the standard SECAM COLOR generator.

PM 5516-T is as PM 5516 but extended with ANTIOPE.

PM 5518 Generator For SECAM/PAL/NTSC and GPIB/IEEE-488 Systems

The PM 5518 expands on the basic PM 5515 by supporting not only the NTSC and PAL TV standards, but also SECAM. In addition, it adds IEEE-488 compatibility as an optional configuration for systems application. As such, it is Philips' most advanced color pattern generator.

A push-button on the front panel selects PAL or SECAM, with a rear panel switch to select NTSC.

In addition to the standard PM 5518, enhanced versions include:

PM 5518-TX operates according to TV standard G, STEREO FM, DUAL SOUND and five pages of teletext and — according to system SECAM L — seven pages of ANTIOPE.

PM 5518-TXS further expands on the -TX by adding VPS for TV standard G.

PM 5518-TXI is the highest performance configuration, specifically aimed at systems applications. In addition to including all of the same features as the -TX by version, it includes RGB, and an IEEE- interface, with "Identification mode" and "Learn mode", plus universal chroma facilities and optional VPS. High stability oscillators are standard for systems use.

These versions offer the same wide choice of test patterns, advanced RF selection, STORE/RECALL facilities and, last but not least, RGB option, as the PM 5515 PAL/NTSC generators.

Specifications

Technical Specifications

Video Carrier

Frequency

Range: 32...900 MHz

IF = Band I: 32...90 MHz

S-Band S1-S10: 104...174 MHz

Band III: 174...230 MHz

S-Band S11-S20: 230...300 MHz

Hyperband H21-H40: 300...470 MHz

Band IV-V: 470...900 MHz

Frequency Selection: Keyboard

Fine Tuning: 250 kHz steps for TV frequencies 100 kHz steps for IF frequencies (32...44.9 MHz)

Frequency Tuning: In positive or negative direction. Tuning speed increase by holding step button

Storage:

a) Possibility for 10 different RF frequencies

b) As a), indicated as TV channel numbers

Indication: 4-digit 7-segment LED display

a) First digit: memory, store and recall position 0...9

b) 2nd, 3rd and 4th digits: 3-digit indication of frequency in MHz. Separate indication for 250 kHz, 500 kHz and 750 kHz steps

PAL and NTSC TV Systems Specifications For PM 5515 and PM 5518

Series	B, G & H	D	I	M	N	M
TV and chroma standard	CCIR, PAL	CCIR, PAL	CCIR, PAL	RTMA, NTSC	CCIR, PAL	RTMA, PAL
No. of lines per picture frame	625	625	625	525	625	525
Field frequency (Hz)	50	50	50	60	50	60
Line frequency (lines/second)	15625	15625	15625	15734	15625	15734
Chrominance subcarrier (MHz)	4.433619	4.433619	4.433619	3.579545	3.582056	3.575611
Sound carrier to vision carrier (MHz)	5.5	6.5	6	4.5	4.5	4.5
Sound modulation	FM	FM	FM	FM	FM	FM
Pre-emphasis (μs)	50	50	50	75	75	75

SECAM TV System Specifications For PM 5516 and PM 5518

TV systems	SECAM B, G, H	SECAM D, K, K1	SECAM L
Sound carrier relative to vision carrier (Hz)	5,500,000	6,500,000	6,500,000
Type and polarity of video modulation	A3F neg.	A3F neg.	A3F pos.
Type of sound modulation	FM	FM	FM
Chrominance subcarrier (Hz)	F_{OB} = 4,250,000 F_{OR} = 4,406,250		
Type of chrominance subcarrier modulation	Frequency modulation		
Transmitted chrominance information	Line sequential D'R and D'B		
Line frequency (lines/second)	15,625		
Field frequency (Hz) (fields/second)	50 (50)		

PM 5515, PM 5516 & PM 5518

c) Keyboard-selectable TV channel numbers (e.g. C21 or C70)

RF Output

RF Output: BNC connector (front panel)
Impedance: 75Ω
Output Voltage: <10 mV
Attenuation: 60 dB, continuous

Video

Video Modulation
Modulation: AM internal-external switchable
Polarity: Negative/positive for SECAM L
Video Input
Video Input: BNC connector (front panel)
Input Voltage (PP): 1V
Max. permissible:
Input Voltage: ±5V
Impedance: 75Ω
Polarity: White level positive
Coupling: DC (clamping on sync.)

Video Output

Video Output:
a) BNC connector
b) SCART connector (Euro-AV connector), pin 19 (rear)
Impedance: 75Ω
Voltage (PP):
a) 1V fixed
b) Variable between 0...1.5V/75Ω
Polarity: Negative
Coupling: DC

Chroma (PAL and NTSC)

Chroma Standards: PAL according to system B, D, G, H, I, (M, N)
NTSC according to system M (switchable)
Selection: Rear panel thumbwheel system switch
Sub-Carrier Frequency: 4.433619 MHz for PAL B, D, G, H, I;
3.575611 MHz for PAL M;
3.582056 MHz for PAL N;
3.579545 MHz for NTSC
Sub-carrier frequencies coupled to line frequency according to selected standard
Tolerance: ≤3 x 10^{-5} (+5...+40°C)
Burst: Position, number of cycles and phase according to selected standard
Amplitude: Chroma with burst
a) Fixed (100%)
b) Continuously variable from 0...150%
Chroma Vectors Inaccuracy: Phase ≤3°, amplitude ≤5% relative to luminance amplitude

Chroma (PAL/NTSC; PM 5518TXI)

Chroma Standards: As PM 5518 TXS with PAL M, N as standard
Sub Carrier Frequency (coupled with line frequency):

PAL B, D, G, H, I	4.433619 MHz
PAL M	3.575611 MHz
PAL N	3.582056 MHz

Tolerance: 10^{-6}
Temperature Coefficient: 2 x 10^{-6}/K
Ageing: 2 x 10^{-6}/year
Sub Carrier Frequency (not coupled with line frequency):
NTSC (4.433 MHz) 4.433619 MHz
Tolerance: <10^{-4} at 23°C
Ageing: 2 x 10^{-6}/K
Sub Carrier Blanking: acc. to system

Chroma (SECAM)

Chroma standards: SECAM B, G, H, D, K, K1 and L
Selection: Two rear panel thumbwheel system switches
Sound Carrier Rel. to Vision Carrier (Hz): B, G, H-5,500,000; D, K, K1, L-6,500,000
Type/Polarity of Video Modulation: 3 AF/neg.
Type of Sound Modulation: FM
Chrominance Sub-Carrier (Hz): f^{OB} = 4,250,000 f^{OR} = 4,406,250
Tolerance: <2 kHz
Type of Chrominance Sub-Carrier Modulation: Frequency modulation
Transmitted Chrominance Information: Line-sequential D'R and D'B
Line Frequency: 15,625 lines/s
Field Frequency: 50 Hz (50 fields/s)
Signals: D'R = -1.9 (E'R - E'Y)
D'B = 1.5 (E'B - E'Y)
Identification: According to TV system in line and frame
Frame Identification: Position in lines 7 to 15; in 1st, 3rd and 5th field etc.: in lines 320 to 328; in 2nd, 4th and 6th field etc.
Line Identification: By burst (chrominance subcarrier reference signal) on the back porch according to TV standard (B, D, G, H, K, K1, L/SECAM)
Amplitude: Line and frame identificationaccording to TV standard, but also variable between 0...150% together with chroma information
Chrominance Signal: According to standard, but also variable
Amplitude: Between 0...150% of the nominal value
Frequency Deviation: Of chrominance subcarrier according to TV standard
Video Pre-Emphasis: Low frequency pre-correction and high-frequency bell filter according to TV standard
Bell Center Frequency: 4.286 MHz
Tolerances: ≤20 kHz

Chroma (SECAM); PM 5518TXI as above except:

Tolerance: <10^{-6}
Temperature Coefficient: 2 x 10^{-6}/K
Ageing: 2 x 10^{-6}/year

Synchronization

Line Frequency: 15,625 Hz (CCIR), 15,734 Hz (RTMA)
Frequency Tolerance: 0.4 Hz (+5 ... +40°C)
Number of Lines: 625 (CCIR), 525 (RTMA)
Field Frequency: 50 Hz (CCIR), 60 Hz (RTMA)
Line and Frame Sync.: According to TV standard, interlacing
Output: BNC connector (front panel)
Sync. Signal: Combined signal with line and field synchronization pulses with amplitude difference
Voltage (open-circuit): 2.6V for line pulse 5.0V for field pulse
Impedance: 6 kΩ
Polarity: Negative

Sound Carrier and Modulation

Sound Carrier (mono): On/off switchable
Frequency: 4.5 MHz, standard M, N;
5.5 MHz, standard B, G, H;
6.0 MHz, standard I;
6.5 MHz, standard D, SECAM L
Tolerance: ≤3 x 10^{-5} (+5...+40°C)
Vision/Sound Carrier Ratio:
13 dB, standard B, G, H;
11 dB, standard D, K, K1, L;
13 dB, standard M, N;
12 dB, standard I
Sound Modulation: FM, internal and external on/off switchable, AM for SECAM L
Pre-Emphasis: 50 µs, standard B, D, G, H, I, K, K1; 75 µs, standard M, N

Internal

Frequency Deviation:
±30 kHz, standard B, G, H;
±15 kHz, standard M, N;
±27.5 kHz, standard I;
±24 kHz, standard D, K, K1
Modulation Depth: 50%, standard SECAM L

External

0.4V will give the same deviation or modulation depth as with internal modulation
Input: DIN connector, pin 3 + 5 (rear panel)
Impedance: 0.5 MΩ
Bandwidth: 40 Hz...15 kHz
Max Input Voltage: ±40V
Output: SCART connector (Euro-AV connector), pin 3 (rear panel)
Impedance: 1 kΩ
Voltage: 0.4V

Teletext for T and TX Versions

Data Synchronization Frequency:
PAL BGI-6.9375 MHz, ~444 x f^H;
SECAM L-6.203125 MHz, ~397 x f^H
Data Coding: Acc. to standards as PAL
Signal Levels: '1' + 66% level, 0+black level; '1' + 100% White level as PAL
Signal Shaping: Cos$_2$ filter

Text Data

Decoder Alignment: No combination possible with test alignment patterns only PM 5515T and PM 5516T
Data Contents: Clock run-in standard, framing code standard, full field, remaining pattern pseudo-random (not PM 5518)
Normal Working Mode: Combinations possible with all test patterns

PM 5515, PM 5516 & PM 5518

Data Lines: 22; 335
Data Contents: ≥5 text pages with special contents for decoder testing for each standard

Signal Output

Teletext Signal Combined with Video Signal: Video output
Modulated RF Signal: RF output, RF from basic unit

For X and TX Versions, Sound Section for Stereo and Second Sound Channel Transmission

Standards: B, G
Sound Carriers: Carrier 1-5.5 MHz; Carrier 2-5.7421875 MHz
Vision Sound Carrier Ratio: Carrier 1-13 dB; Carrier 2-20 dB
Frequency Tolerance: <3 x 10^{-5} (+5...+40°C)

Modulation

FM, internal and external on/off switchable
Pre-Emphasis: 50 µs

Internal Modulation

Sound Channel 1: 1 kHz on/off switchable;
3 kHz on/off switchable
Deviation: ±30 kHz in mono/dual-channel
±15 kHz in stereo, right channel switched off
±30 kHz in stereo, left and right channels switched on with 1 kHz internal signal
Sound Channel 2: 1 kHz, on/off switchable
Deviation: ±30 kHz

External Modulation

Sound Channels 1 & 2 Input Voltage: 0.4V will give the same deviation as the internal signal

Inputs

DIN connector (rear panel)
Contacts: Pin 2 (ground),
pin 3 sound channel 1,
pin 5 sound channel 2
Impedance: 0.5 MΩ
Bandwidth: 40 Hz...15 kHz
Max. Permissible Voltage: +40V

Outputs

SCART connector (Euro-AV connector)
Contacts: Pin 3 sound channel 1, pin 1 sound channel 2
Impedance: 1 kΩ
Voltage: 0.4V

IEEE-488 Interface (PM 5518TXI only)

Allows selection and control of all functions

Operating Mode Detection

Pilot Frequency: 54.6875 kHz (3.5 x f_{line})
Tolerance: <3 x 10^{-5} (+5...+40°C)
Modulation: AM
Modulation Depth: 50%
Identification Frequencies: 117.5 Hz (f_{line}/133) stereo mode;
274.1 Hz (f_{line}/57) dual-channel mode
Deviation of 2nd Sound Carrier: ±2.5 kHz by modulation of carrier with unmodulated pilot
For standards D, I, M, N the stereo versions X and TX also offer all mono facilities.

VPS for TXS Versions

VPS Video Programming System for pre-programmed recording with home video recorders according to German broadcasting organizations ARD, ZDF and ZVEI

Data Synchronization Frequency: 5 MHz
Bit Length: 400 ns
Modulation: Bi-phase modulation
Data Coding: According to the guideline issued by ARD, ZDF and ZVEI
Signal Levels: '0' = black level, '1' = 71.4% of white level
Signal Shaping: Cos$_2$ filter
Location of Data: Line 16
Data Contents: 9 different freely programmable non-volatile sets of VPS data preset at factory; each with 15 words (8 bits), including clock run-in, special identification and date of transmission
Normal Operating Mode: Combination possible with all test patterns and teletext; on/off switchable
Programming: Via keyboard and text strip inserted in the test pattern
Text Strip: 6 different positions, or not visible

RGB Option

RGB Outputs
BNC connectors (rear panel)
Output Voltage (PP): 0.7V/75Ω
Impedance: 75Ω
Sub-Carrier Output
BNC connector (rear panel)
Output Voltage (PP): 1V/75Ω
Impedance: 75Ω
Sync. Output
BNC connector (rear panel)
Output Voltage (PP): 2V/75Ω
Impedance: 75Ω

Universal PAL/NTSC Chroma Molule

PAL Systems: B, D, G, H, I, M, N
NTSC Systems: M

Optional Configuration Performance Table

	TV System												RGB	IEEE 488
Model Number	**NTSC**	**PAL**					**SECAM**							
	M	**D**	**G**	**I**	**M**	**N**	**L**	**B**	**D**	**G**	**H**	**K1**		
PM 5515	a	a	a	a	a, opt.	a, opt.							opt.	
PM 5515X	a	a	a, b										opt.	
PM 5515-T	a	a	a, c	a, c									opt.	
PM 5515-TX	a	a	a, b, c	a									opt.	
PM 5515-TXS		a	a, b c, d											
PM 5516							a	a	a	a	a	a	opt.	
PM 5516-T							a, e	a	a	a	a	a	opt.	
PM 5518	a	a	a	a	a, opt.	a, opt.	a	a	a	a	a	a	opt.	
PM 5518-TX	a	a	a, b, c	a, c			a, e	a	a	a	a	a	opt.	
PM 5518-TXS	a	a	a, b c, d	a, c			a, e	a	a	a	a	a	opt.	
PM 5518-TXI	a	a	a, b, c d, opt.	a, c	a	a	a, e	a	a	a	a	a	std.	std.

a. Mono sound *b. Stereo sound* *c. Teletext* *d. VPS* *e. antiope-teletext*

Sub-Carrier Frequency (coupled with line frequency):

PAL B, D, G, H, I	4.433619 MHz
PAL M	3.575611 MHz
PAL N	3.582056 MHz
NTSC	3.579545 MHz

Sub-Carrier Frequency (not coupled to line frequency):

NTSC (4.433 MHz)	4.433619 MHz

Tolerance: <100 x 10^{-6} at 23°C
Sub-Carrier Blanking: According to system

Hyperband Module (only for instruments made before 1987)

Total Frequency Range: 32...900 MHz
IF + Band I: 32...104 MHz
S-Band S1 - S10: 104...174 MHz
Band III: 174...230 MHz
S-Band S11 - S20: 230...300 MHz
Hyperband H21 - H40: 300...470 MHz
Bands IV-V: 470...900 MHz

General Specifications

Power Supply

Voltage: 100, 120, 220, 240 V -12/+10%
Frequency: 50/60 Hz ±5%
Power Consumption: Depends on version
Dimensions: 300mm W x 14mm H x 395mm L
Weight: Approx. 10 kg depending on version
Included: PM 9538 RF cable, BNC TV connector 758, mains cable, operating manual

Ordering Information

Models

January 1989 prices

PM 5515MM PAL/NTSC Pattern Generator	$1900
PM 5518 NTSC/PAL/SECAML Pattern Generator	$2395

Optional Configurations*

PM 5515MM+RGB Standard PM 5515MM plus RGB; PAL/NTSC	2200
PM 5515+GX Standard PM 5515MM plus PAL G stereo	2500
PM 5515X+RGB Same, plus RGB	2900
PM 5515+GT Standard PM 5515MM plus PAL G teletext	2500
PM 5515GT+RGB Same, plus RGB	2900
PM 5515+GTX Standard PM 5515MM plus PAL G stereo and teletext	2825
PM 5515GTX+RGB Same, plus RGB	3225
PM 5515+TXS Standard PM 5515MM plus PAL G stereo, teletext, and VPS	3425
PM 5515TXS+RGB Same, plus RGB	3725
PM 5518+RGB Standard PM 5518, plus RGB	2695
PM 5518TX Standard PM 5518 plus PAL G stereo, PAL G/I teletext, and SECAM L antiope	3450
PM 5518TX+RGB Same, plus RGB	3850
PM 5518TXS Standard PM 5518 plus PAL G stereo and VPS, PAL G/I teletext, and SECAM L antiope	4050
PM 5518TXS+RGB Same, plus RGB	4450
PM 5518TXI Standard PM 5518 plus PAL G stereo, PAL G/I teletext SECAM L antiope, Universal Chroma RGB and IEEE-488	5150

For additional models configured for use outside N. America (including the PM 5516), contact factory

Accessories (Also see page 485)

PM 9539/01 RF cable and 300Ω trafo	30
PM 9075 75Ω BNC-BNC Cable	11
PM 9561 19-inch Rackmount Unit	130

Options (for existing units)

PM 9546 Universal Chroma Unit	220
PM 9545* Hyperband Module	550
PM 9544** VPS Module	650
PM 9543 RGB Output	350

** Replacement unit only for older models; hyperband is now standard on all current models*

*** See VPS for TXS on previous page for specifications Note: All options must be installed by the Philips service department*

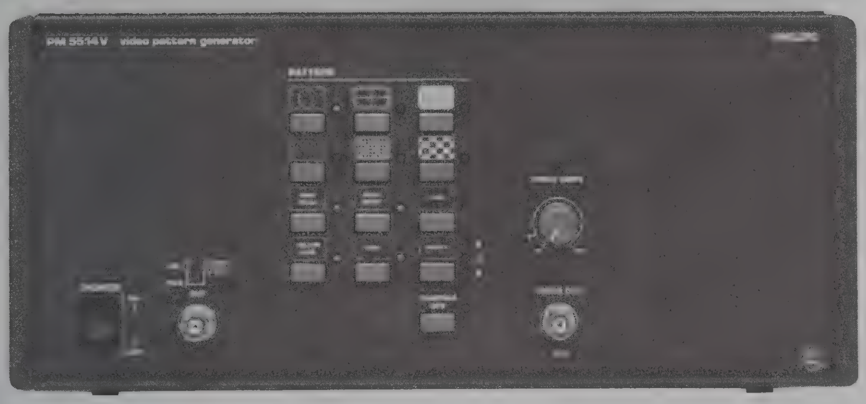
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 5514V



PM 5514V

PM 5514V Video Color Pattern Generators

- Economical video testing
- Over 70 color and monochrome pattterns and combinations
- Simple to operate

PM 5514V for Monitor Testing

The economical PM 5514V is the ideal solution for workshops handling large volumes of computer or CCTV monitors.

It offers a choice of over 70 color patterns and combinations, together with simple and secure microprocessor-controlled operation. All you need to do is connect the CCTV or monitor to be tested, key-in the required test pattern, and check that the TV or monitor performance is correct.

The selected settings are clearly indicated by LEDs next to the pushbuttons. Setting-up couldn't be quicker or more convenient, giving you exactly the test pattern you want, in only a few seconds.

A front-panel CVBS output is standard, and an additional rear-panel RGB output is available as a factory-fitted option. The RGB output includes SYNC and sub-carrier signals, to meet the specific requirements of color monitors and other video equipment. Since many monitors accept only RGB signals, this will in many cases be an essential testing facility. (RF carrier and sound sections, for TV, excluded; see PM 5515 if required.)

A choice of models is available for NTSC M, or for PAL B, G, I or D standards.

Every Pattern You Need — at the Touch of a Button

Twelve push-buttons make the selection of eighteen different test patterns possible. These patterns can be used for checking and aligning the monochrome and chrominance sections of color TVs, monitors and VCRs.

Patterns and uses include:

- **Circle** — for linearity and geometry.
- **Center cross/Border lines** — centering and pin-cushion correction.
- **White** — 'White D', purity and beam current adjustment.
- **Dot pattern** — static convergence.
- **Cross hatch/Center indication** — dynamic and corner convergence, centering.
- **Checkerboard pattern** — useful for basic alignments.
- **Grey scale** (8 step) — video amplifier linearity.
- **Multiburst** (8 bars of definition lines) — video bandwidth and resolution.
- **VCR** — specially designed for checking bandwidth, linearity, sensitivity and AGC of chroma amplifiers in VCRs.
- **Color bar** — overall color performance checks
- **DEM pattern** — color demodulator and sub-carrier frequency checks.
- **Purity** (3 primary colors and combinations) — purity checks

Specifications

Technical Specifications

Video

Modulation
Modulation Type: AM internal
Polarity: Negative
RF Sync. Level: 100%
Video Output
Output Connection:
a) BNC connector
b) SCART (Euro AV) connector pin 19 (rear)
b) Variable between 0...1.5V into 75Ω
Impedance: 75Ω
Voltage (P-P):
a) 1V fixed
b) Variable between 0...1.5V into 75Ω
Polarity: Negative
Coupling: DC

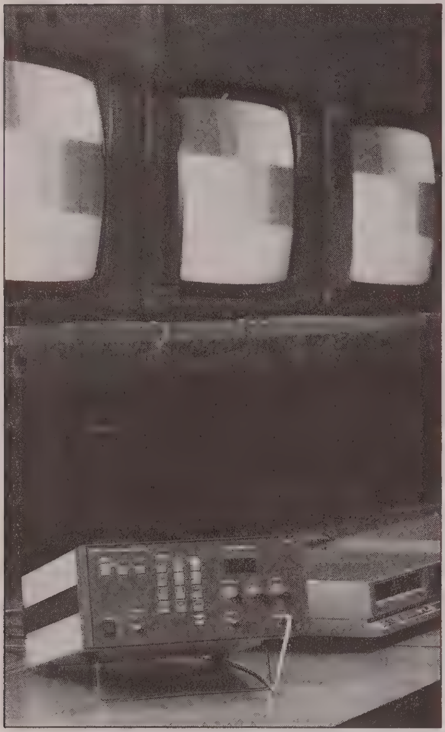
Chroma

Chroma Standard: PAL, B, G, H, I and D, or NTSC M (fixed for each instrument; not switchable)
Sub-Carrier Frequency: 4.433 619 MHz for standard B, G, H, I;
3.579 545 MHz for standard M NTSC
Both coupled to line frequency
Tolerance: <3 x 10^{-5} (+5...+40°C)
Burst: Position, number of cycles according to standard
Amplitude: Chroma with burst, fixed 100%, on/off switchable
Chroma Vectors Inaccuracy:
Phase: ≤3°
Amplitude: ≤5% relative to luminance amplitude

Sound Carrier and Modulation

Sound Carrier Mono: On/off switchable
Frequency: 5.5 MHz, standard B, G, H;
6.0 MHz, standard I;
6.5 MHz, standard D
Tolerance: <3 x 10-5 (+5...+40°C)
Vision/Sound Carrier Ratio: 13 dB, standard B, G, H, D; 12 dB, standard I
Sound Modulation: RM internal/external on/ off switchable
Pre-Emphasis: 50 µs
Internal: Frequency deviation
±30 kHz, standard B, G, H
±27 kHz, standard I
±24 kHz, standard D
External:0.4V gives the same deviation as with internal modulation
Input: DIN connector pins 3 & 5 (rear panel)
Impedance: 0.5 MΩ
Bandwidth: 40 Hz...15 kHz
Max. Input Voltage: ±40V
Output: SCART (Duro AV) connector, pin 3 (rear panel)
Impedance: 1 kΩ
Voltage: 0.4V

PM 5514V



Synchronization
Line Frequency: 15 625 Hz for CCIR, 15 734 Hz for RTMA
Number of Lines: 625 for CCIR, 525 for RTMA
Field Frequency: 50 Hz for CCIR, 60 Hz for RTMA
Line + Frame Sync.: According to standard, interlacing
Sync. Signal: Combined signal; line and frame synchronization pulses with amplitude differences
Output: BNC connector (front panel)
Voltage (open circuit): 2.6V for line pulse, 5V for field pulse
Impedance: 6 kΩ
Polarity: Negative

RGB (Optional)
RGB Outputs: BNC connectors (rear)
Output Voltage (pp): 0.7V into 75Ω
Impedance: 75Ω
Subcarrier Output: BNC connector (rear)
Output Voltage (pp): 1V into 75Ω
Impedance: 75Ω
Sync. Output: BNC connector (rear)
Output Voltage (pp): 1V into 75Ω
Impedance: 75Ω

General Specifications

Power Supply

Line Voltage: 110/127V or 220/240V
Tolerance: -12...+10%
Frequency: 50 Hz
Tolerance: 5%
Power Consumption: ≤42W
Dimensions: 300mm W x 140mm H x 395mm L
Weight: 6.5 kg

Included With instrument: Manual, rf output cable (BNC-DIN)

Ordering Information

Models

January 1989 prices

PM 5514VMM Video Pattern Generator; NTSC	$1370
PM 5514VMM RGB Video Pattern Generator with RGB; NTSC	1685

Optional Configurations

Alternate configurations are available for PAL B, G, I or D. Please contact factory for details.

Accessories (Also see page 485)

PM 9539/01 75Ω RF cable with 75Ω/300 Ω impedance transfer	30
PM 9075 75Ω/300 Ω RF cable, BNC-BNC	11
PM 9561 19 inch Rackmount Kit	130
PM 9543 RGB Option	350

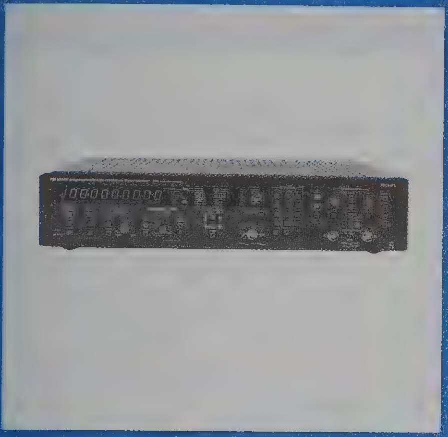
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

Counters/Timer Counters


Page 324 PM 6654C

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Page 351 1912A

Whether you use frequency counters or counter/timers, on the bench, in the field, or in automated systems, Fluke and Philips can address your time and frequency measurement needs from economical solutions to state of the art performance.

Fluke and Philips provide the broadest selection of non-microwave counters in the industry. Models range from the 1900A, with a price to suit any budget, to the high performance PM 6654C which offers 15 measuring functions and nine digits of resolution in a one second measuring time. We also offer the PM 6669, the lowest cost IEEE-488 counter available, the PM 6665, the lowest cost IEEE-488 timer/counter available, and the PM 6666, the lowest cost fully programmable IEEE-488 timer/counter available.

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Systems Counter/Timers 323
Benchtop Timer/Counters 334
Multifunction Counters 348
Frequency Only Counters 359

Selection Guide

Model	Frequency Range	Max. Display Digits	Best Sensitivity	High Resolution Computing Counting	Frequency Period Ratio Totalizing	Single Shot Time Interval Resolution	Phase	RPM	Pulse Width	Freq. Burst	Volt Max/ Min.	Page No.
Systems Timer/Counters												
PM 6666	120 MHz/1.1 GHz	9	10 mV	7 digits/s	•	100 ns					•	334
PM 6652C	120 MHz/1.5 GHz	9½	20 mV	7 digits/s	•	100 ns	•	•	•	•	•	323
PM 6645C	120 MHz/1.5 GHz	9½	20 mV	9 digits/s	•	2 ns	•	•	•	•	•	323
1953A	125 MHz	9	30 mV		•	100 ns						332
Benchtop Timer/Counters												
PM 6665	120 MHz/1.1 GHz	9	10 mV	7 digits/s	•	100 ns		•				334
7250A	80 MHz	7	10 mV		•	100 ns		(2)				339
7260A	125 MHz/1.3 GHz	8	10 mV		•	100 ns		(2)				339
7261A	125 MHz/1.3 GHz	8	10 mV		•	10 ns		(2)				339
PM 6670	120 MHz	8	10 mV	7 digits/s	•	100 ns	•	•	•			342
PM 6671	120 MHz	8	10 mV	7 digits/s	•	100 ns	•	•	•	•		342
PM 6672	1 GHz	8	10 mV	7 digits/s	•	100 ns	•	•	•	•		342
Multifunction Counters												
1900A	80 MHz	6	25 mV		(3)							364
1910A	125 MHz	7	15 mV		(3)							365
1911A	250 MHz	7	15 mV		(3)							365
1912A	520 MHz	7	15 mV		(3)							365
PM 6669	120 MHz/1.1 GHz	9	10 mV	7 digits/s	•			•	•			355
PM 6673	120 MHz	9	10 mV	7 digits/s	•					•		348
PM 6674	550 MHz	9	10 mV	7 digits/s	•					•		348
PM 6675	600 MHz (dir. gated)	9	5/10 mV	7 digits/s	•					•		348
PM 6676	1.5 GHz	9	10 mV	7 digits/s	•					•		348
Frequency Only Counters												
PM 6667	120 MHz	7	15 mV	7 digits/s								367
PM 6668	1 GHz	7	15 mV	7 digits/s								367
7220A	1.3 GHz	9	10 mV	(1)						•		339

Note 1: Has optional X1000 10 Hz-10 kHz resolution multiplier.
Note 2: Has cpm x 100.
Note 3: Except ratio.

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Selection Guide

Model	Rise-Time, Duty Factor, MATH	Triggering				Options					Page No.
		Adjustable Level Selection	Input Coupling	Hold-Off	External Control (Note 4)	Best Timebase	Battery	Analog Output	IEEE-488 Control		
									Partial	Full	
Systems Timer/Counters											
PM 6666		Auto, Var	ac/dc			MTCXO	•			•	334
PM 6652C	•	Auto, Var	ac/dc	•	•	Oven		•		•	323
PM 6654C	•	Auto, Var	ac/dc	•	•	Oven		•		•	323
1953A		Variable	ac/dc			Oven				•	332
Benchtop Timer/Counters											
PM 6665		Variable	ac/dc			MTCXO	•		•		334
7250A		Variable	ac			Oven	•		•		339
7260A		Variable	ac/dc	•		Oven	•		•		339
7261A		Variable	ac/dc	•		Oven	•		•		339
PM 6670		Variable	ac/dc			Oven	•	•	•		342
PM 6671		Variable	ac/dc	•	•	Oven	•	•	•		342
PM 6672		Variable	ac/dc	•	•	Oven	•	•	•		342
Multifunction Counters											
1900A			ac			RTXO	•				364
1910A			ac			TCXO	•				365
1911A			ac			TCXO	•				365
1912A			ac			TCXO	•				365
PM 6669		Auto, +0-	ac			MTCXO	•		•		355
PM 6673		+0-	ac		•	Oven	•	•	•		348
PM 6674		+0-	ac		•	Oven	•	•	•		348
PM 6675		+0-	ac		•	Oven	•	•	•		348
PM 6676		+0-	ac		•	Oven	•	•	•		348
Frequency Only Counters											
PM 6667		Auto	ac			TCXO	•				367
PM 6668		Auto	ac			TCXO	•				367
7220A			ac			Oven	•		•		339

Note 4: Provides 3 functions: measurement arming control, external reset, and frequency burst averaging.

Introduction

Applications for frequency and time-related measurements vary considerably. Requirements can include high-accuracy frequency calibration of RF signals, frequency measurements on noisy signals, accurate propagation delay measurements, phase shift in filters, high resolution counting on low frequency tone control signals, etc.

The instruments which perform these time-related measurements are generally known as counters. There are quite a number of names for various classes of these products which date back to the era before microprocessors were incorporated into counters. Today, there are two categories of these instruments: frequency counters and timer/counters.

Frequency Counters

A frequency counter has a single input channel, and sometimes an additional prescaled input for measuring high frequencies. The most basic units offer frequency-only measurements. Most counters offer the following functions:

- Frequency
- Period

More versatile instruments also offer:

- Totalizing (Pulse Counting)
- Frequency ratio (relative mode)
- Frequency deviation (relative mode)
- Pulse Width
- RPM (freq x 60)

Typical applications for these products range from high accuracy calibrations of telecommunications equipment (normally in the RF range) down to low-cost frequency indicators for small repair workshops and hobbyists.

Timer/Counters

In addition to the frequency measurements noted above, a timer/counter can also perform time interval measurement between two events (start and stop event). A timer/counter is therefore characterized by its dual and identical input channels, the start and stop channels (usually labeled A and B). A third input channel can be added for prescaled HF frequency measurements. Almost all counter/timers offer the following functions:

- Frequency
- Period
- Time Interval (Channel A to Channel B)
- Frequency Ratio (Channel A/Channel B)
- Totalizing

More advanced models offer a wealth of different functions, with the most common listed below:

- Pulse Width
- Rise/Fall Time
- Voltage Measurements
- Phase Delay (A to B)
- Duty Factor

Fluke and Philips Electronic Counters

Frequency Counters		Timer/Counters	
Frequency-Only Counters	Multi-Function Frequency Counters	Bench-Top Timer/Counters	Systems Timer/Counters
7220A PM 6667 PM 6668	1900A 1910A 1911A 1912A PM 6669 PM 6673 PM 6674 PM 6675 PM 6676	7250A 7260A 7261A PM 6665 PM 6670 PM 6671 PM 6672	1953A PM 6666 PM 6652C PM 6654C

Timer/counters are found in the lab or on the service bench and also in systems. These systems vary from small temporary set-ups to large ATE systems. Consequently, there is a choice between bench top and systems models. Bench top units can be equipped with an IEEE-488 interface, allowing programming of most major functions. Systems units allow programming of all input settings, including trigger level and attenuation.

Optional Accessories

The conditions of use are important. Use in the field, on a laboratory bench or in an automatic test system require different options such as: battery supply, BCD output, analog output (for recording on a strip-chart recorder), GPIB/IEEE-488* bus interface, rack-mount facilities, ultra-high stability oven oscillators, etc.

In selecting a counter, the availability of a wide range of such options is of great importance especially when the type of application may change after some time in use.

Front-end Circuitry Requirements

The requirements for input signal-conditioning when making frequency and time measurements are somewhat contradictory as the following observations will illustrate.

Frequency Counting

Figure 1a shows a sinewave signal crossing the hysteresis band of the input circuit. Each period of the sinewave that crosses the hysteresis band should cause a clean pulse that can be counted by the digital circuitry.

Noise on the sinewave, however, causes the signal to pass through the hysteresis band more than once per sinewave period giving false counts. Figure 1b shows how an expanded hysteresis band can prevent this type of error.

Time Interval Measurement

Figure 2a shows a pulse, the duration of which is to be measured. Triggering at 50% of amplitude should start the time measurement at A and stop it at B.

The hysteresis of the input circuit, however, causes triggering to occur at A1 and B1. The different slopes of leading and trailing edges cause different delays, resulting in a faulty measurement. A very narrow hysteresis band as shown in Figure 2b will reduce these errors.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

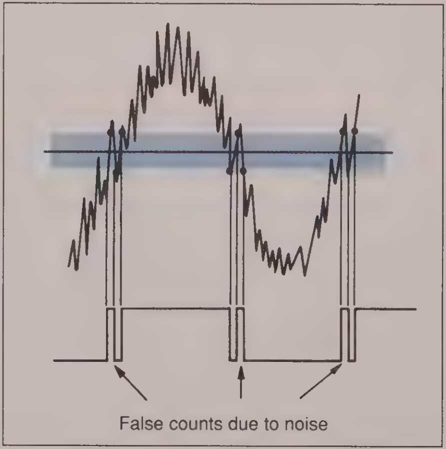


Figure 1a.

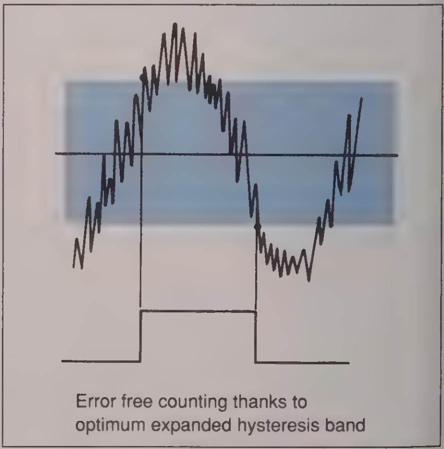

Error free counting thanks to
optimum expanded hysteresis band

Figure 1b.

Error-Free Triggering

Figure 1b shows that "error-free" frequency counting is obtained by a wider hysteresis band or, in other words, by an attenuated input signal.

Thus for frequency measurement a continuously variable input attenuator permits optimum matching of the input signal to the counter's trigger sensitivity.

Figure 2b shows that a lower hysteresis voltage will minimize the time measurement error.

Thus a low hysteresis voltage (narrow trigger window) together with a continuously variable trigger level setting permits accurate time interval measurements.

AC-Coupling

Frequency counting on sinewaves or on generally symmetrical signals is best achieved with AC-coupled inputs. AC-coupling has no temperature drift problems, while added DC signal components are eliminated. This assures simple, stable, and thus, reliable triggering.

Frequency counters also need to measure on narrow pulses or other waveforms.

Triggering on any waveform, having any duty factor can be performed by means of a trigger level off-set in the input channel amplifier, see Figure 3.

DC-Coupling

Time interval measurements with accurately set trigger levels, or those that are wave form-independent, require DC-coupling. This might include rise time measurement on a pulse, requiring 10% to 90% level setting, or a pulse duration measurement with accurate setting of trigger levels at 50% of the pulse amplitude.

High Resolution Computing Counting

Measuring Resolution

The controlling and computing power of modern microcomputers enables frequency measurements to be made in the most logical way. The formula for computing frequency is:

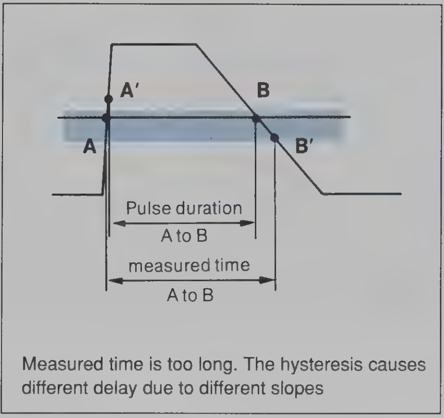
$$\text{Frequency} = \frac{\text{Number of cycles}}{\text{Time}}$$

Modern microcomputer-based frequency counters do precisely that which is given in the frequency definition

1. They count the number of complete input cycles.
2. They measure the effective gate-time, which is the time duration of the totalized number of input cycles.
3. Thereafter, they compute the value of:

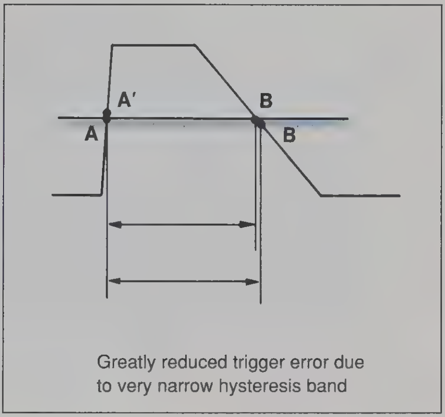
$$\frac{\text{Number of cycles}}{\text{Time}}$$

Finally the microcomputer computes the resolution to define the number of digits to be displayed.



Measured time is too long. The hysteresis causes different delay due to different slopes

Figure 2a.



Greatly reduced trigger error due to very narrow hysteresis band

Figure 2b.

A computing frequency counter contains two counting registers. One counting register counts the number of input cycles, while the other register counts the number of 10 MHz reference clock pulses, to measure the time duration.

The required measuring time can be selected independently and can be varied continuously as well as in fixed steps.

The actual measuring time is synchronized with the input signal and is therefore exactly a multiple of complete cycles. This way, the traditional ±1 input cycle error is avoided. During the same time, the time counter has totalized the number of 100 ns (10^{-7}s) reference clock pulses or 2 ns in the case of PM 6654C. The count error is ± one clock pulse. The total gate-time is the number of clock pulses x 10^{-7}s or x $2x10^{-9}$s for the PM 6654C.

To obtain the frequency or period value, only a simple division has to be made.

$$\text{Frequency} = \frac{\text{Counted input cycles}}{\text{Time counts x } 10^{-7}\text{s}^*}$$

$$\text{Period} = \frac{\text{Time counts x } 10^{-7}\text{s}^*}{\text{Counted input cycles}}$$

The ±1 count error is ±100 ns* (10^{-7}s).* The resolution or relative count error is:

$$\text{Rel. resolution} = \frac{\pm 10^{-7}\text{s}^*}{\text{Measuring time}}$$

**For the ultra-high resolution PM 6654C, the figure is $2x10^{-9}$s*

Note that the resolution is independent of the frequency value. When measuring, for example, a line frequency with 1s of measuring time, a readout of at least 7 accurate digits e.g., 50.78349 Hz, will result. A conventional counter would in this case only display 2 digits, e.g., 51 Hz. This is because conventional counters are not syn-

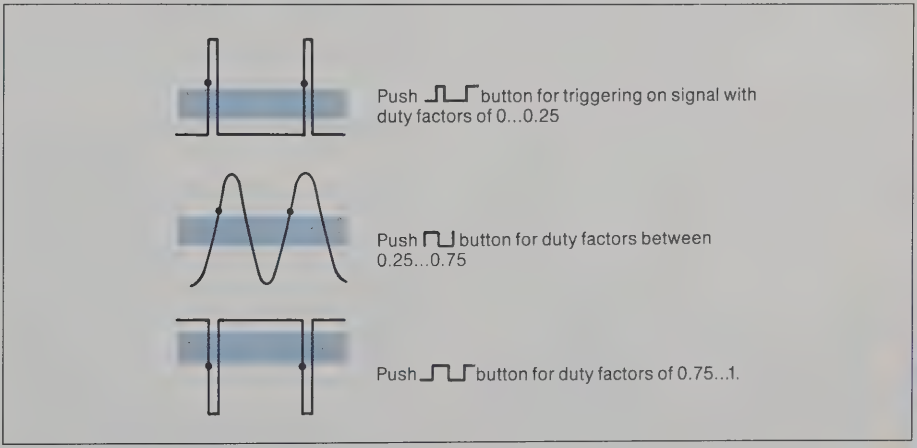

Push ⎍ button for triggering on signal with duty factors of 0...0.25
Push ⎍ button for duty factors between 0.25...0.75
Push ⎍ button for duty factors of 0.75...1.

Figure 3.

chronized with the input signal, but with the internal time base. The ±1 count error is now found in the input cycle counting register, which implies that the resolution for conventional counters is:

$$\text{Rel. resolution} = \frac{\pm 1}{\text{Frequency x gate time}}$$

One obvious advantage with microprocessor-based computing counters is thus the very good resolution even at low frequencies.

Another advantage is the possibility to mathematically process the measuring data such as displaying counts per minute (RPM) instead of counts per second, display phase delay in degrees based on the relative time delay between two signals, etc.

Crystal Oscillators

A counter's maximum accuracy is ultimately limited by its time base reference accuracy.

Depending on the application requirement, most counter models can be ordered with a choice of different crystal oscillator time base options.

The oscillator with the highest available stability (PM 9691), features a stability of $5x10^{-10}$/24h, and can be included in the high accuracy counters of the PM 667. and PM 665. Series.

Selection of Time-Base Option

Depending on the application accuracy requirement, operating temperature range and tolerated recalibration interval, a suitable time base selection can be made. As general indication, one can state that the accuracy limitation, caused by the time base is as follows:

No. of Digits	Type of Crystal Oscillator	Option Numbers
5-6	Standard or Uncompensated	Standard or /.1.
6-7	TCXO w/analog Compensation	TCXO, -111, -112, /.2. or PM 9678
7-8	TCXO w/Mathematic Compensation (MTCXO) or Oven Control	MTCXO, -131, -132, -10, -20 or /.3. /.4. or PM 9607, PM 9679, PM 9690
8-9	Ultra High Stability Oven Control	/.5. or PM 9691

Time-Base Inaccuracy (Relative Error):

Timebase error is determined by the summary of the following terms:

$$\frac{\partial f}{F} = \pm \frac{\partial fa}{F} \pm \frac{\partial ft}{F} \pm \frac{\partial fs}{F}; \quad \text{where}$$

∂f : the deviation from the nominal 10 MHz crystal frequency

F : nominal 10 MHz crystal frequency

$\frac{\partial fa}{F}$: relative deviation due to aging

$\frac{\partial ft}{F}$: relative deviation due to temperature changes from calibration temperature

$\frac{\partial fs}{F}$: relative deviation due to supply voltage and/or supply mode variation

PM 6654C & PM 6652C

PM 6654C

PM 6654C & PM 6652C System Timer/Counters
High accuracy FREQUENCY AND PERIOD measurements of 9 digits in one second
High sensitivity 1.5 GHz input with wide 10 mV_{RMS}...12 V_{RMS} dynamic range
TIME-INTERVAL resolution down to 0.5 ps averaged and 2 ns single shot
Measuring modes incl.: Phase, Rise/Fall Time, Duty Factor, Vmax/min/pp of input
8 pre-programmable front panel menus: digital readout of trigger levels
Mathematical functions
Trigger facilities include Arming, Hold-Off, Ext. Gating and Auto Trig. Level

Introduction

Philips' PM 6652C and PM 6654C high performance, fully programmable timer/counters satisfy virtually all frequency and time measurement requirements, especially in R & D laboratories and automatic test systems applications.

The measuring functions and appearance of both instruments are the same. The difference is found in resolution, accuracy and measuring speed. The PM 6652C has a 10 MHz (100ns) clock frequency, whereas the extra high resolution PM 6654C features a 500 MHz (2ns) real-time clock resolution. Thus, the PM 6654C's measuring circuitry gives some 50 times better resolution or measuring speed than found in the PM 6652C and in most other counters on the market. Thanks to its short measuring cycle times, the extra high resolution PM 6654C is particularly well suited to high speed automatic test systems. Both the PM 6652C & 6654C timer/counters offer extremely powerful measuring capabilities. With 14 frequency, time and voltage measuring modes, 100% GPIB/IEEE-488* Bus programmability, over 400 readings/second Bus speed, 2ns single shot resolution and 1.5 GHz frequency range, the PM 6654C challenges most other timer/counters.

Voltage Measurements

Both timer/counters offer standard volt measurements: V_{max}, V_{min}, V_{DC}, V_{pp} or even V_{RMS}, whether on LF sinewaves or high speed pulses.

In combination with the time measurements: DUTY FACTOR, PERIOD, PULSE WIDTH, DELAY, RISE-AND-FALL TIME and PHASE, these PULSE VOLTAGE measurements allow automatic test systems to measure pulse and other input parameters, that could only be viewed previously on an oscilloscope.

Powerful FREQUENCY Measuring Capabilities

High accuracy FREQUENCY and PERIOD measurements can be made in a one second measuring time with resolution of 9 digits in the PM 6654C and 7 digits in the economy version PM 6652C. Both models perform advanced frequency measurements, including externally gated frequency measurements, burst frequency and multiple burst frequency average measurements on down to 200ns narrow bursts (500ns for PM 6652C).

Trigger HOLD-OFF, when activated in the FREQUENCY and PERIOD modes, acts as a digital low-pass filter to ignore noise and interference, thereby preventing erroneous measurements.

Mathematics

The MATH (mathematics) facility allows scaling and/or off-setting of measured results before display. This significantly extends the range of application by enabling calibration or unit conversion as in the following examples:

V_{pp} measurements can be converted to V_{RMS}; frequency readings from a transducer can be calibrated as RPM, liters/s, gallons/min or m/s; phase measurements can be converted from degrees to radians and pulse reflections in faulty cables can be directly calibrated for fault location finding in meters of cable length.

The Ultimate in Time Interval Measuring Accuracy

A unique combination of high resolution, high trigger accuracy and special trigger control facilities puts these instruments among the most powerful timers on the market.

The high technology PM 6654C with its 2ns single shot resolution allows time interval measurements to be made to an accuracy and resolution well beyond those of normal timer/counters.

Repetitive signals allow significantly improved resolution by averaging of measuring results. Time intervals, pulse widths, rise and fall times can be measured this way down to sub-picosecond resolution with the PM 6654C and down to 10 ps resolution with the PM 6652C.

Trigger Accuracy

Ultimately, no timer measures more accurately than its trigger accuracy. Therefore high speed/high sensitivity input stages, high trigger level setting accuracy and shortest possible trigger delays. The PM 6652C's and PM 6654C's inputs feature very fast 1 ns rise times and 20 mV_{RMS}, sensitivity over a wide -5V...+5V dynamic range. Trigger level accuracy is assured by the digital setting and readout. At the push of a button, the counter displays, simultaneously, the set trigger

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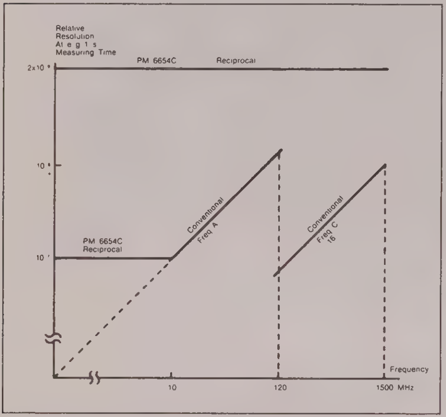
* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 6654C & PM 6652C

levels of both the A and B channels with a 10 mV resolution. Trigger levels may be set by knob controls, keyboard entry, or automatically.



The PM 6654C benefits from the 500 MHz internal clock, by utilizing RECIPROCAL counting for all frequencies.
The PM 6652C selects, automatically, RECIPROCAL or CONVENTIONAL counting in order to achieve the highest possible resolution, for any frequency.

The Actual Trigger Points are Displayed

Automatic hysteresis compensation ensures that the actual triggering occurs at the set trigger level and is not delayed by the input hysteresis. Systematic trigger errors are thus kept to an extremely low level.

Powerful Extra Trigger Controls

The PM 6652C & 6654C provide full control over start and stop triggering. Arming and trigger hold-off enable unwanted signals to be ignored which would otherwise trigger the counter. Arming avoids false starts while a wide range variable trigger hold-off prevents false stops. The set hold-off time can be read on the display.

Designed for Ease-of-Use

For user-convenience, the PM 6652C & 6654C provide superior intelligence. Both counters contain two microprocessors, one to automate the operation and for communication with the front panel, the other for fast measuring control and data handling.

Simple Function Selection

Function selection is achieved by means of only one single control. The up/down function selector with moving cursor in the display window indicates clearly which measuring mode is selected. See figure on following page.

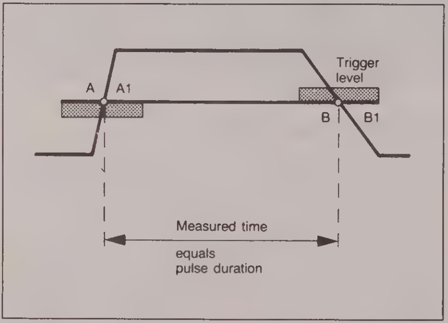
Stored Front Panel 'Menus' P1...P8

Once all front panel controls have been set, all the settings can be stored in a memory for later recall. Storage capacity for eight such pre-programmable front panel menus is provided in non-volatile (EAROM) memory. This means these programs are not lost during line voltage interruptions and no batteries are needed for memory back-up.

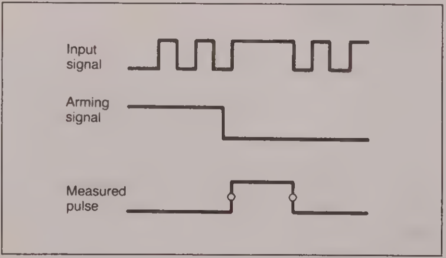
The stored programs memorize even numeric values such as trigger level voltages, measuring time and the mathematical conversion factors K and L. Recalling such programmed front panel menus is as simple as the selection of a measuring function: just pushing one button. All front panel menus can also be stored and recalled via the IEEE-488 bus.

PM 6654C programmable high resolution timer/counter
2ns single shot resolution
START/STOP TOTALIZE A
MATH
HOLD OFF
MEASURING TIME
DISPL HOLD
SET VIA KEYBOARD

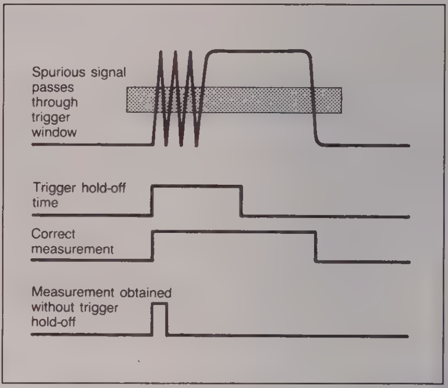
The trigger level READ function displays simultaneously the trigger levels of both the A and B channels, whether being set manually with a vernier or via the keyboard or in the AUTO trigger mode.



The PM 6652C/6654C feature hysteresis compensation. The trigger level is lowered on positive slopes and raised on negative slopes, resulting in a residual hysteresis band which is virtually 10 mV p-p.



The arming input facility prevents the counter from being triggered as long as this input is kept high. Releasing this input arms the counter, which is then ready for triggering, immediately on the first incoming signal.


Spurious signal passes through trigger window
Trigger hold-off time
Correct measurement
Measurement obtained without trigger hold-off

Use of the variable trigger hold-off prevents false stops due to spurious signals such as ringing or relay contact bounce. It also enables time measurements to be made on double pulses, bursts or other complex signals.

Automatic Triggering

The PM 6652C & 6654C have three different trigger level setting modes:

- AUTO selection for foolproof operation and maximum convenience.
- Digital selection via the keyboard for maximum setting accuracy.
- Manual potentiometer setting for increased flexibility.

In the AUTO mode, the counter measures first the maximum and minimum voltages of the input signals. Thereafter, the microcomputer calculates the 50% values to set the trigger levels. When measuring rise or fall times, the 10% and 90% levels are calculated.

Trigger Indicators

Tri-state trigger indicator LEDs on the PM 6652C & 6654C blink to indicate that the inputs are triggered. This feature is of great help when setting the trigger levels manually or via the keyboard.

Variable Measuring Time

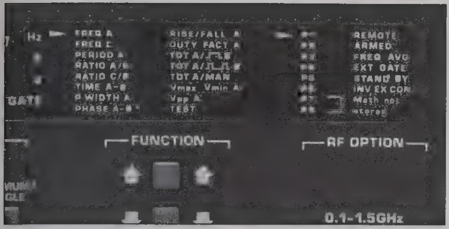
Another microcomputer benefit is the continuously variable measuring time, which is not limited to decade steps. It is possible, for example, to select 2.4 seconds if one second does not give sufficient resolution. This avoids the need to select a time-wasting 10-second measuring period. Pressing the READ button shows instantaneously the measuring time selected.

For a microsecond measuring time or measurements of one-shot phenomena, MINIMUM/ SINGLE button is used.

Trigger Level Outputs

Trigger level outputs on the rear panel are available for readout on an oscilloscope. Set trigger levels can then be viewed with respect to the input signals. They can also be used as bus programmable DACs.

PM 6654C & PM 6652C



Detail of front showing up/down moving cursor fo clear indication of selected function.

Choice of Crystal Oscillators

The time base crystal oscillator determines the accuracy limit of the timer/counters. The Crystal oscillator summary shows which of the five stability versions best fits the user's requirements. The choice ranges from an economy standard oscillator to the 5 x 10^{-10}/24h high-stability ovenized oscillator PM 9691 for high accuracy measurements and fewer recalibrations. The high-stability crystal oscillators are also available as retrofittable options for later upgrading of the counter performance. By means of the external reference input, it is possible to utilize the user's own frequency standard, when available.

Powerful IEEE-488 Bus Capabilities

Both the PM 6652C and PM 6654C are fully programmable, including all front-end controls and trigger level voltages. The optional PM 9696 interface board makes the counters IEEE-488/IEC-625 bus-compatible at a small additional cost. Advanced software features are available, including bus learn mode and programmable delimiters. In addition, the high-speed dump mode allows the user to fully exploit the high-resolution / high-measuring speed of the PM 6654C, allowing up to 400 - 500 measurements per second. Pre-set limit monitoring is another useful feature, allowing the counter to SRQ when low or high limits are exceeded.

Powerful, Flexible Software for User Convenience

The PM 6652C & 6654C's bus interface fully complies with IEEE-488/IEC-625-1 hardware standards, as well as with the code and format conventions (software) of IEEE-728/IEC-625-2. To satisfy application needs for both temporary interfaced instrument clusters — and for permanent test systems, the PM 6652C & 6654C feature a flexible and powerful software approach. Three programming modes give ease and simplicity of programming and powerful, high-speed bus operation. Other friendly features include:

- Acceptance of all available input delimiters as well as output of any delimiter (hardware and/or software selectable) to suit any controller.
- In the 'normal' programming mode, only modifications to the current programming status need to be sent as program messages.
- The mnemonics used are short (maximum three characters) for maximum communication and interpretation speed — but they are easily recognized and can be sent in any sequence. For instance SM 1.5 means: set measuring time to 1.5s.
- Numerical values for trigger levels, measuring times and conversation factors K and L are accepted in all three standardized formats: NR 1, NR 2 and NR 3 (IEEE-728, IEC-625-2, ANSI-X3.42).

Built for ATE Systems

Particular system requirements are met by the inclusion of the following options: The cooling fan, PM 9612 can be built-in for operation in rack-systems, with excessive ambient temperatures. With the PM 9611, the counter is supplied wired with rear panel measuring input connectors instead of the front panel inputs. The counters can also be fitted with rack mount slide PM 9613 for quick and easy accessibility, when mounted in a rack.

Bus Learn Mode

Ease of programming is further enhanced by the bus 'learn' mode, which lets the counter write its own program messages, thereby eliminating programming errors and the need for debugging. In LOCAL mode the counter can be set manually to check whether the measurement is correctly performed. The controller can then ask the counter for the corresponding program string which can be 'copied' by the controller and used for reprogramming the counter.

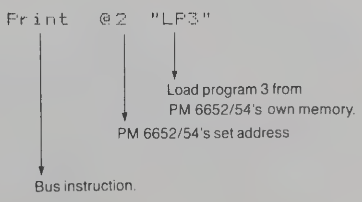
High Speed Data Output

Depending on the measuring function, the PM 6652C & 6654C's high bus speed allows 30-50 measurements per second to be made when used in the normal data output mode. To record very high-speed phenomena, the high- speed dump mode enables some 400-500 measurements per second to be made. In this mode, the raw measuring data from the counting registers are output without being processed by the counter's micro-computer. The algorithms for subsequent processing in the bus controller are given in the manual. A third output data mode is for monitoring processes or for 'go/no-go' testing. It completely eliminates the need for bus communication, as long as the measurement results are within set limits. An SRQ-alarm is given by the counter as soon as a measuring result exceeds the set limits stored in the counter's memory.

System Reliability Testing

Reliable system operation is greatly enhanced by the built-in facility of both hardware

The ultimate in bus operation simplicity
It is only required to manually set and store all desired timer/counter controls in one of the counter's own memory locations P1...P8, then recall via the bus the manually stored 'menu' with a ***single*** *bus command. Example command from a 1722A Instrument Controller to a PM 6652C/6654C.*



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PM 6654C & PM 6652C

and software testing. The self-diagnostic TEST 1...5 can be activated via the bus, when the counter is not busy with measurements, ensure dependable hardware performance. System hang-ups caused by, for instance, the absence of an input signal can easily be identified by the comprehensive status byte information. The PM 6652C & PM 6654C feature over 30 different status byte messages.

MATE/CIIL Interface

The counters can be equipped with a MATE/CIIL Interface, for system use in MATE (modulars ATE) environments. Via the high-level CIIL (Control Interface Intermediate Language), all counter functions are fully controlled.

Specifications

Measuring Modes for PM 6652C

Frequency A

Range: 0.1 Hz...120 MHz (0.01 Hz...200 kHz when HOLD-OFF is selected).
Typically 120...160 MHz at 50 mV sensitivity
Mode: Reciprocal below 10 MHz and when HOLD-OFF, EXT GATE or AVERAGE is selected. Conventional above 10 MHz.
LSD Displayed:

$$\frac{2.5 \times 10^{-7}\text{s} \times \text{FREQ}}{\text{measuring time}} \quad \text{(reciprocal)}$$

$$\frac{2.5}{\text{measuring time}} \quad \text{(conventional)}$$

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext. Controls: EXT GATE, AVERAGE, ARMING

Frequency C Optional

Range: 100 MHz...1.5 GHz
Mode: Conventional. (Reciprocal when EXT GATE or AVERAGE is selected).
LSD Displayed:

$$\frac{40}{\text{measuring time}} \quad \text{(conventional)}$$

$$\frac{2.5 \times 10^{-7}\text{s} \times \text{FREQ}}{\text{measuring time}} \quad \text{(reciprocal)}$$

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \text{time base error}$$

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext. Controls: EXT GATE, AVERAGE, ARMING.

Period A

Range: 100 ns...10^{10}s
LSD Displayed:

$$\frac{2.5 \times 10^{-7}\text{s} \times \text{PERIOD}}{\text{measuring time}}$$

Resolution: 1 or 2 LSD units, LSD and resolution is 100 ns when SINGLE PERIOD is selected.
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Number of Cycles Averaged:

$$\frac{\text{measuring time}}{\text{PERIOD}} \quad \text{or a single period}$$

Ext. Controls: EXT GATE, AVERAGE, ARMING

Time Interval A-B, Pulse Width A, Rise/Fall A; Single

Range: 100 ns...10^{10}s
LSD Displayed: 100 ns (TIME <10^3s)

$$\frac{5 \times \text{TIME}}{10^{10}} \quad (\text{TIME} \geq 10^3\text{s})$$

Resolution: 1 LSD unit
Accuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}} \pm \frac{\text{trigger error}}{\text{TIME}}$$

± time base error

Min. Amplitude for RISE/FALL TIME Measurements: 500 mV_{pp}
Ext. Controls: ARMING

Time Interval A-B, Pulse Width A, Rise/Fall A; Averaged

Range:
Time Interval: 0 ns...100s
Pulse Width: 4 ns...100s
Rise/Fall Time: 8 ns...100s
LSD Displayed:

$$\frac{2.5 \times 10^{-8}\text{s}}{\sqrt{N}}$$

Resolution:

$$\frac{100 \text{ ns}}{\sqrt{N}}$$

or 1 LSD unit, whichever is greatest.

Accuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}} \pm \frac{\text{trigger error}}{\sqrt{N} \times \text{TIME}}$$

$$\pm \text{time base error} \pm \frac{\text{syst. error}}{\text{TIME}}$$

Min. Dead Time Stop to Start: 250 ns
Number of Samples Averaged (N):

$$\frac{\text{measuring time}}{\text{pulse repetition time}}$$

Min. Amplitude for RISE/FALL Measurements: 500 mV_{pp}
Ext. Controls: AVERAGE, ARMING.

Measuring Modes for PM 6654C

Frequency A

Range: 0.01 Hz...120 MHz (0.01 Hz...200 kHz when HOLD-OFF is selected).
Typically 120...160 MHz at 50 mV sensitivity
Mode: Reciprocal
LSD Displayed:

$$\frac{5 \times 10^{-9}\text{s} \times \text{FREQ}}{\text{measuring time}}$$

When HOLD-OFF or EXT GATE is selected, see specification for PM 6652C.

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext.Controls: EXT GATE, AVERAGE, ARMING

Frequency C optional

Range: 100 MHz...1.5 GHz
Mode: Reciprocal
LSD Displayed:

$$\frac{5 \times 10^{-9}\text{s} \times \text{FREQ}}{\text{measuring time}}$$

When EXT GATE is selected, see specification for PM 6652C.

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \text{time base error}$$

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext.Controls: EXT GATE, AVERAGE, ARMING

Period A

Range: 8 ns...100s
LSD Displayed:

$$\frac{5 \times 10^{-9}\text{s} \times \text{PERIOD}}{\text{measuring time}}$$

When HOLD-OFF or EXT GATE is selected, see specification for PM 6652C.

Resolution: 1 or 2 LSD units, LSD is 1 ns and resolution 2 ns, when SINGLE PERIOD is selected.

Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{PERIOD}}\pm\frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Number of Cycles Averaged:

$$\frac{\text{measuring time}}{\text{PERIOD}}\text{ or a single period}$$

Ext.Controls: EXTGATE, AVERAGE, ARMING

Time Interval A-B, Pulse Width A, Rise/Fall A; Single

Range: 8 ns...10^{10}s
LSD Displayed: 1 ns (TIME <10s)

$$\frac{5\text{ x TIME}}{10^{10}}\text{ (TIME }\geq\text{10s)}$$

Resolution: 2 ns (TIME <10s); 1 LSD unit (TIME ≥10s)
Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}}\pm\frac{\text{trigger error}}{\text{TIME}}$$

$$\pm\text{ time base error }\pm\frac{\text{syst. error}}{\text{TIME}}$$

Min. Amplitude for RISE/FALL TIME Measurements: 500 mV_{pp}
Ext. Controls: ARMING
Note: When HOLD-OFF is selected, see specifications for PM 6652C.

Time Interval A-B, Pulse Width A, Rise/Fall A; Averaged

Range:
Time Interval: 0 ns...100s
Pulse Width: 4 ns...100s
Rise/Fall Time: 8 ns...100s
LSD Displayed:

$$\frac{2.5\times10^{-9}\text{s}}{\sqrt{N}}$$

Resolution:

$$\frac{10\text{ ns}}{\sqrt{N}}$$

or 1 LSD unit, whichever is greatest.

Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}}\pm\frac{\text{trigger error}}{\sqrt{N}\text{ x TIME}}$$

$$\pm\text{ time base error }\pm\frac{\text{syst. error}}{\text{TIME}}$$

Min. Dead Time Stop to Start: 50 ns
Number of Samples Averaged (N):

$$\frac{\text{measuring time}}{\text{pulse repetition time}}$$

Min. Amplitude for RISE/FALL Measurements: 500 mVpp
Ext. Controls: AVERAGE, ARMING.
Note: When HOLD-OFF is selected, see specification for PM 6652C.

Measuring Modes Common for PM 6652C and PM 6654C

Duty Factor A

Range: 0...1 - (250 ns x Pulse rep. rate)
Example: 0...0.9999 at 50 Hz; 0...0.9997 at 1 kHz; 0...0.5 at 2 MHz
Frequency Range: 0.03 Hz...2 MHz
LSD Displayed:

$$\frac{2.5\times10^{-7}\text{s}}{\text{measuring time}}$$

Resolution: 100 ns x pulse rep. rate/√N or 1 LSD unit, whichever is greatest
Accuracy:

$$\pm\frac{4\text{ ns x FREQ}}{\text{DUTY FACTOR}}\pm\frac{\text{resolution}}{\text{DUTY FACTOR}}$$

$$\pm\frac{\text{trigger error}}{\sqrt{N}\text{ x PULSEWIDTH}}$$

Number of Cycles Averaged (N): Measuring time x pulse rep. rate
Ext.Controls: None

Totalize A

Range: 1...10^{18}
Frequency Range: 0...120 MHz and 0.01 Hz...200 kHz when HOLD-OFF is selected
Pulse Pair Resolution: 8 ns
Manual Mode: Controlled by pushbutton START/STOP
External Mode: Totalizing on A during pulse duration on B or between start/stop pulses on B.
Accuracy:

$$\pm\frac{\text{Pulse rate A x trigger error B}}{\text{total counts}}$$

Ext. Controls: ARMING (not valid in manual mode).

Ratio A/B

Range: 10^{-9}...10^{10}
Frequency Range:
0.1 Hz...120 MHz/0.01 Hz...10 MHz (0.01 Hz...200 kHz/0.01 Hz...10 MHz when HOLD-OFF is selected).
LSD Displayed:

$$\frac{2.5\text{ x RATIO}}{\text{measuring time x FREQ A}}$$

Resolution: 1 or 2 LSD units
Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{RATIO}}\pm\frac{\text{trigger error B}}{\text{measuring time}}$$

Ext. Controls: ARMING

Ratio C/B

Range: 10^{1}...10^{11}
Frequency Range:
100 MHz...1.5 GHz/0.01 Hz...10 MHz.
LSD Displayed:

$$\frac{40\text{ x RATIO}}{\text{measuring time x FREQ C}}$$

Resolution: 1 or 2 LSD units
Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{RATIO}}\pm\frac{\text{trigger error B}}{\text{measuring time}}$$

Ext. Controls: ARMING

Phase A-B

Range: 0...360° x (1 - 250 ns x FREQ)
Example: 0...360° at 50 Hz; 0...359.9° at 1 kHz; 0...180° at 2 MHz
Frequency Range: 0.03 Hz...2 MHz
LSD Displayed:
1° Measuring time ≤180µs;
0.1° Measuring time 180 µs...1.8 ms;
0.01° Measuring time ≥1.8 ms
Resolution: 1 LSD unit
Inaccuracy:

$$\pm\frac{4\text{ ns x }360^\circ\text{ x FREQ}}{\text{PHASE}}\pm\frac{\text{resolution}}{\text{PHASE}}$$

$$\pm\frac{\text{FREQ x }360^\circ\text{ x trigger error}}{\sqrt{N}\text{ x PHASE}}$$

$$\pm\frac{\text{systematic error}}{\text{PHASE}}$$

Input Voltage: 100 mV...3.5V or 1V...35V (RMS sine).
Number of Cycles Averaged (N): Measuring time x FREQ A
Ext. Controls: None

V_{max}, V_{min}, V_{pp} A

Range: -50V...+50V; DC and 100 Hz...120 MHz
LSD Displayed:
10 mV for signals within ±5V
100 mV for signals outside ±5V
Resolution: 1 LSD-unit

Typical Inaccuracy (mV):
DC and 100 Hz...20 MHz
Input Signals Within ±5V:
±(20 mV + 2% of reading)
Input Signals Outside ±5V:
±(200 mV + 3% of reading)

Typical Inaccuracy (mV):
20 MHz...80 MHz (50 Ohm):
Input Signals Within ±5V:
±(20 mV + 6% of reading)
Input Signals Outside ±5V:
±(200 mV + 7% of reading)

High-Freq. Error: >80 MHz (50Ω) or >20 MHz (1 MΩ) deviation is typically ±3 dB
Ext. Controls: None

PM 6654C & PM 6652C

Definitions

Synchronization Modes:

Conventional Mode means that the gate time is synchronized with an integer number of clock pulses. The error is ±1 input cycle. (Only used in the PM 6652C above 10 MHz).

Reciprocal Mode means that the gate time is synchronized with an integer number of input cycles. The error is ±1 clock pulse, i.e. ±100 ns (PM 6652C) or ±2 ns (PM 6654C). The use of this mode gives 7 digits (PM 6652C) or 9 digits (PM 6654C) resolution for a one second measuring time.

LSD Displayed:

Unit value of the Least Significant Digit displayed. All calculated LSDs (see section Measuring modes) should be rounded to the nearest decade before display (e.g. 5 ns will be 10 ns and 0.4 Hz will be 0.1 Hz) and cannot exceed the 10th digit.

Accuracy:

The accuracy (relative error) of a measurement is dependent on 4 factors:

- rel. resolution
- rel. time base error (if any)
- rel. trigger error (if any)
- rel. systematic error (if any)

Accuracy + ± rel. resolution ± rel. time base error ± rel. trigger error ± rel. systematic error

Resolution

For Multiple Event Measurements: FREQUENCY, PERIOD and RATIO, the resolution is the smallest increment between two measuring results. The measuring resolution is due to the ±1 count error. After calculation, the result to be displayed is truncated to include only significant digits, giving a measuring resolution of 0.2...2 LSD units. Total resolution, including LSD resolution is therefore 1 LSD unit (70% probability) or 2 LSD units (30% probability) but can always be reduced to 1 LSD unit by increasing the measuring time somewhat.

For Single Event Measurements: PERIOD SINGLE and TIME INTERVAL SINGLE, resolution is one clock pulse period, regardless of the measuring time.

For Statistical Measurements: TIME INTERVAL AVERAGE, RISE/FALL TIME, PULSE WIDTH, PHASE and DUTY FACTOR, the resolution is the smallest increment between two measuring results with a confidence level of 95%.

Time Base Error:

The relative time base error is the relative deviation of the clock pulse frequency from 10 MHz. Rel. time base error = Δf/10 MHz. See spec. for oscillators.

Trigger Error:

Trigger error (T.E.) is the absolute measurement error due to input noise causing triggering which is too early or too late.

Frequency, Period, Ratio: T.E. = ± Noise Voltage (V_{pp})/Signal slew rate (V/s);
T.E. = ± 1/FREQ x π x S/N-ratio (sinewave)

Time Interval, Rise/Fall Time, Pulse Width, Duty Factor: T.E. = ± Noise Voltage (V_p)/slew rate at START point ± Noise Voltage (V_p)/slew rate at STOP point

Phase: T.E. = ± 1/(FREQ x π x S/N-ratio) (sinewave, same S/N-ratio for both channels).

Systematic Errors:

When a systematic error is known, the measured value can be compensated by using the MATH function.

Time Interval, Pulse Width: Syst. error < ±2 ns (PM 6654C) or < ±4 ns (PM 6652C)

Rise/Fall Time: Syst. error = TIME INTERVAL Syst. error ±

$$\pm \frac{2\% \text{ of } V_{pp} \text{ (A)} + 5 \text{ mV}}{\text{slew rate (A) at 10\% (V/s)}}$$

$$\pm \frac{2\% \text{ of } V_{pp} \text{ (A)} + 5 \text{ mV}}{\text{slew rate (A) at 90\% (V/s)}}$$

Phase (AC-Coupling, Trigger Level = 0V)

Sinewave:

Syst. error
<arcsin (5 mV/U_{max}A) - arcsin (5 mV/U_{max}B)

Triangular wave:

$$\text{Syst.error} < \frac{5 \text{ mV} \times 90°}{U_{max}A} - \frac{5 \text{ mV} \times 90°}{U_{max}B}$$

Input Specification

Inputs A and B

Frequency Range: *DC-coupled:* 0...120 MHz; *AC-coupled:* 20 Hz...120 MHz

Rise Time: Approx 1 ns

Sensitivity: 20 mV_{RMS} sinewave or 60 mV_{p-p} (0...60 MHz); 30 mV_{RMS} sinewave or 90 mV_{p-p} (60...120 MHz)

Min. Pulse Duration: 4 ns

Attenuation: x 1, x 10 (fixed)

Hysteresis Band: Approx. 40 mV_{p-p}
Hysteresis compensation is automatically performed in TIME A-B, P Width A, RISE/FALL A, PHASE A-B and DUTY FACTOR measuring modes; resulting in a residual hysteresis band which is virtually 10 mV_{p-p}.

Dynamic Input Voltage Range:
60 mV_{p-p} within ±5V_{p-p} ±5V_{DC} (x 1);
600 mV_{p-p} within ±50V_{p-p} ±50V_{DC} (x 10)

Trigger Level Selection: Manually via keyboard (10 mV steps); Manually via potentiometers; Auto trigger

Trigger Level Range: -5V...+5v (x 1); -50V...+50V (x 10)

Trigger Slopes: Positive or negative

Trigger Level Output: Set trigger levels for channel A and B, -5V...+5V, available at rear panel (BNC-connectors).

Trigger Level Readout: Set trigger levels for channel A and B are displayed with a resolution of 10 mV (x 1) or 100 mV (x 10)

Trigger Indicators: Tri-state LED indication
On: Signal is above the set trigger level
Blinking: Triggering occurs
Off: Signal is below the set trigger level

AUTO Trigger: The AUTO trigger will automatically set A and B trigger levels to 50% of input signal amplitude (10% and 90% for rise/fall time measurements).
Frequency range: 100 Hz...120 MHz
Measuring cycle time: Approx. 300 ms + measuring time.

Note: Auto trigger requires a repetitive signal. Input signal may have any duty factor.

Coupling: DC/AC

Channel Input: Separate A and B or common via A

Impedance: Separate A and B: 1 MΩ//35 pF or 50Ω nominal (A and B);
Common A: 0.5 MΩ//70 pF nominal or 50Ω nominal (A). Open input (B).

Max. Voltage Without Damage:
1 MΩ (x 1): 260V_{RMS} ≤20 kHz, declining to 12 V_{RMS} at ≥1 MHz
1 MΩ (x 10): 260V_{RMS} ≤20 kHz, declining to 100V_{RMS} at 1 MHz and to 25V_{RMS} at 120 MHz
50Ω: 12V_{RMS} DC...120 MHz

Input C (Option/PM 9610)

Frequency: 100 MHz...1.5 GHz

Operating Input Voltage Range:
10 mV_{RMS}...12 mV_{RMS} (100 MHz...1 GHz)
30 mV_{RMS}...12 mV_{RMS} (1...1.5 GHz)

Coupling: AC

Impedance: 50Ω nominal; VSWR ≤2

AM Tolerance: 98%; minimum signal must exceed minimum operating input voltage

Max. Voltage Without Damage: 12V_{RMS}; overload protection with PIN diodes

Input D (Ext. standard in)

Range: 100 kHz...10 MHz

Coupling: AC

Impedance: 1.5 kΩ nominal

Sensitivity: 400 mVRMS

Max. Voltage Without Damage: 25V_{RMS}

Note: As external reference frequency, only 10 MHz will give correct decimal point and unit indication. With the optional frequency multiplier PM 9697 references of 1 and 5 MHz can also be accepted.

Input E (Ext. reset)

Electrical reset, equivalent to front panel RESET pushbutton. Counter is reset when input E is high. A new measurement can be made after input E has returned low. The measurement will start after a delay of approx. 50 ms to 100 ms (depending on selected function) plus time needed for synchronization with the input signal.

Active High Level: ≥2V

Passive Low Level: ≤0.5V

Impedance: 2 kΩnominal

Max. Voltage Without Damage: ±25V

Min. Pulse Duration: 50 ns

PM 6654C & PM 6652C

Input F (Arming, Ext. gate, Average)

A 4-position rear panel switch gives choice of external control of the counter
OFF: No function selected
ARMING: The counter is prevented from starting a new measurement when input F is high. A high-to-low transition arms the counter to start a new measurement. Arming is not applicable in TOT A (manual), PHASE and DUTY FACTOR measurements.
AVERAGE: Frequency (channel A or C), period A and time interval A-B measurements are interrupted when input F is high. The measurement is continued again when input F is low.
EXT. GATE: The signal on input F defines start and stop of the measuring time and overrides the set MEASURING TIME. The measurement will start when input F goes high, after a synchronization delay. The measurement will stop when input F returns low, after a synchronization delay.
High Level: ≥2V
Low Level: ≤0.5V
Impedance: 2 kΩ nominal
Max. Voltage Without Damage: ±25V
Min. Pulse Duration (Arming): 200 ns
Min. Pulse Duration(Ext. gate): 500 ns
Min. Pulse Duration (Average):
PM 6652C: 500 ns; *PM 6654C:* 200 ns
Internal Delay: Approx. 50 ns

Output Specifications

Output G (10 MHz out)

Output Frequency: 10 MHz
Output Level: 1.3V_{p-p} in 50Ω load
Output Protection: Short-circuit proof

Output H (Gate Open)

The gate status output allows monitoring on an oscilloscope of the actual measuring time and the trigger hold-off time.
Output Levels:
Main gate closed: Approx.4.5V;
Main gate open: Approx. 0V;
Hold-off time: Approx. 1.2V
Output Impedance: Approx. 1.5 kΩ
Internal Delay: Approx. 150 ns
Output Protection: Short-circuit proof

Outputs I and J (Trigg Level Out)

Buffered output for set trigger levels on channels A and B. The range is -5V...+5V unaffected by the input attenuator setting (x 1 or x 10). The outputs can be used as two independent bus programmable DACs.
Output Levels: -5V...+5V
Output Impedance: Approx. 2 kΩ
Output Protection: Short-circuit proof
Non-Linearity Error: Less than ±5 mV
DC-Offset: Less than ±7 mV
Setting Time: Less than 1 ms

Auxiliary Functions

Measuring Time/Display Time

The measuring time can be selected in three different ways:
Variable: The measuring time is continuously variable 0.1 ms...96s, with clear setpoints at 0.1 ms, 1 ms, 10 ms, 0.1s, 1s, 10s and 96s. Selected variable measuring time is displayed, without any delay, when depressing the measuring time "READ" push-button.
Minimum/Single: With minimum/single activated the counter will perform single event measurements for: PERIOD A, RATIO A/B, RATIO C/B, TIME A-B, P WIDTH A, and RISE/ FALL A.
A minimum measuring time of approx. 2µs is performed for FREQ A, FREQ C in PM 6654C.
A minimum measuring time of approx. 1µs is performed for FREQ A, FREQ C in PM 6652C and for PHASE A-B and DUTY FACTOR A in both PM 6652C and PM 6654C.
The variable MEASURING TIME/DISPLAY TIME control will now act only as display time control. The measured result is displayed during the set display time and a new measurement will start at the next input signal.
Ext. Gate: The use of EXT GATE (see INPUT specifications) will override the set measuring time. The external gate duration must be in the range 500µs...96s.

Display Hold:

Depressing the DISP HOLD push-button sets display time to infinity and freezes the last measurement result. A new measurement can be initiated using RESET.

Hold-Off:

With trigger HOLD-OFF activated the counter ignores re-triggering (channel A) or stop-triggering (channel B) during the set hold-off time. The hold-off function is applicable in all channel A measuring modes and also on channel B in the TIME A-B mode. The hold-off function can be used as low-pass filter with variable cut-off frequency between 5 Hz...150 kHz for FREQUENCY and PERIOD measurements.
Range: 5µs...200 ms or 0 (OFF)
Read-Out: The hold-off time is measured and displayed by pressing the READ push-button.
Monitor: The set hold-off duration is visible via the GATE OPEN output.

Note: When hold-off is active, the frequency measurements are limited to 0.01 Hz...200 kHz (PM 6652C and PM 6654C) and clock resolution in all measuring modes will always be 100 ns (PM 6654C).

Time Interval Delay (T.I. delay):

The T.I. delay is a bus-programmable Hold-off, active in PM 6654C in the modes:
- Time Interval A-B, single
- Pulse width A, single
- Rise/Fall Time A, single

Range: 100 µs...99s
Accuracy: 25 µs ±1% of set value

Mathematics:

The mathematical functions of PM 6652C and PM 6654C make it possible to offset a measuring value or to change scale factor (normalizing). The offset facility allows adding or subtracting a reference value to the measured value before display, e.g. measurement of tuned receiver frequency, by measuring the local oscillator frequency (IF-offset).
The scaling facility allows multiplying of the measured value by a constant before display, e.g. conversation of frequency to RPM.
The scaling and offset features may be combined, so that the displayed value equals K*X+L. X is the measured value and K and L are constants.

Check:

10 MHz internal reference is connected to the counting logic of input channels A and B. Self-test of most measuring functions can be selected.

Reset:

Manual via push-button or electrical via input E. Reset will clear keyboard entry status, clear an active STORE state, and/or start a new measurement.

Power On/Stand By:

In "ST BY" position, power is available to maintain an ovenized crystal oscillator.

Test Function:

The counter performs a choice of 5 self test routines of the logic and computing functions. The functions tested are: ROM (No. 1), RAM (No. 2), EAROM (No. 3), measuring logic (No. 4) and display (No. 5), Test No. 6 when selected will perform all tests 1...5 in a sequence.
At power-up a limited test sequence is performed.

Programs P1...P8:

Eight front panel "menus" can be stored in and recalled from a non-volatile memory. All front and rear panel settings can be stored; except hold-off value (but status of push-button "HOLD-OFF on/off" is stored). Programs P7 and P8 can not store the mathematical functions.

Time Base:

For specifications see chart on following page.

General Specifications

Display

Read Out: 10 digits, sign and exponent (engineering notation) 11 mm high-efficiency LED.
Unit Indicators: 3 LEDs indicating Hz, s or V. Any prefix (kHz, µs) is indicated by the exponent on the display.
Gate Lamp: Indicates that main-gate is opened and measurement takes place.

PM 6654C & PM 6652C

St By: Stand-by indication with LED when instrument is not switched ON.
Remote: Indicates that the counter is remotely controlled via the BUS interface option (IEC-625, IEEE-488).
Armed/Freq Avg/Ext Gate: Indicates position of rear panel EXT CONTROL switch (LOCAL mode) or programmed setting of EXT CONTROL function (REMOTE mode).
Cursor: Indicates selected measuring function and/or selected front panel menu (Programs P1...P8).

Power Requirements:

In addition to the normal line voltage supply, the PM 6652C and PM 6654C can also be powered by an external DC voltage; 17V...29V.
Line: 115/230V ±15%; 45...440Hz 60 VA
Line Interference: Below VDE 0871 (B) and MIL STD 461
Safety: According to IEC 348 and CSA 556 B

Dimensions and Weight:

440 mm W x 89 mm H x 440 mm L (excl. 19" brackets) (17.3 in W x 3.5 in H x 17.3 in L)
Net: Approx. 8 kg (17.5 lb)
Shipping: Approx. 10 kg (22 lb)

Environmental Conditions

Ambient Temperature:
Storage and transport: -40°C...+70°C;
Rated range of use: -5°C....50°C
To allow air convection, at least 2 cm free space is required above and below the counter. Without any free air space around the counter (tightly packed 19 inch racks), the built-in fan option PM 9612 is necessary at ambient temperatures above 40°C.
Humidity:
Operating: 10...90% RH, no condensation;
Storage: 5...95% RH
Altitude/Barometric Pressure:
Operating: 5 000m (15 00 ft) -53.3 kN/m²
Storage: 15 000m (50 000 ft) -15.2 kN/m²

GPIB/IEEE-488 Bus Data

(PM 9696 Installed)

The PM 6652C and PM 6654C timer/counters are IEEE-488 bus programmable through the optional hardware interface PM 9696B.

Programming Instructions:

Programming modes: The counter can be programmed in 3 different ways:
Remote recall of P1...P8: Manually stored front panel menus are recalled with one single bus-command (LP1...LP8).
Bus learn mode: The programming codes for all manually set controls are sent from the counter and stored in the controller's memory with one single bus-command. The string of codes can later be returned to the counter for reprogramming.
Normal mode: Only changes in the current programming status need to be programmed, and can be sent in an arbitrary order. Any number of spaces can be inserted anywhere in the programming string. The counter complies with IEC-625-2 and IEEE-728 and accepts all standardized formats for numeric values; NR1, NR2 and NR3.

Output Messages:

High Speed Dump Mode: The contents of the counting registers are sent to the controller without being processed by the internal microcomputer. The processing must be done in the controller instead.
Limit Monitoring: The MATH constants K and L will specify upper and lower limits for the measurement. When the input signal exceeds either of the limits, an SRQ-alarm is sent to the controller. Limit monitoring is not applicable in the V_{max} V_{min} measuring mode.

Timing Characteristics:

Max. Data Output Rate:
Normal mode: 30-50 readings/sec.;
High speed dump mode: Approx. 420 readings/sec.
V_{max}, V_{min} *or* V_{p-p}: 3-4 readings/sec.

Optional Accessories

Analog Recorder Output PM 9695

The digital-to-analog converter PM 9695 provides a high resolution analog output e.g. for recording frequency stabilities of oscillators, filters and crystals on a strip chart recorder. In frequency control systems having analog feedback, the DAC serves as an extremely accurate frequency-voltage converter. The PM 9695 permits conversion of any three consecutive digits; as such it functions as a magnifying glass to focus on the most important part of the readout.
Decade Conversion: Any 3 consecutive digits can be selected. The value of the least significant of the 3 digits can be selected with a 12-position switch.
Normal Mode: Analog output is directly proportional to digital input. 000 produces 0.000V. 999 produces 0.999V.
Output:
Zero output: 0V;
Full scale deflection: 0.999V
Connector: BNC

Ext. Reference Frequency Multiplier PM 9697:

To accept external reference frequencies other than 10 MHz, the frequency multiplier PM 9697 can be ordered.
With this option installed, the PM 6652C or PM 6654C can accept external reference frequencies of 1 MHz, 5 MHz or 10 MHz. All other input specifications as for "Input D".
Included With Instrument: Operating manual, power cord, rackmounting brackets

Ordering Information

Models

January 1989 prices

PM 6652C 120 MHz, 100 ns Timer/Counter	$2280
PM 6654C Plus 2 ns resolution	2500

Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit /suffix by selecting 1 digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.

Input Frequency Option:

/0-- Standard 120 MHz	N/C
/5-- 1.5 GHz (PM 9610/01)	add 695

Reference Oscillator Option:

/-1- Standard Crystal	N/C
/-2- TCXO (PM 9678B/01)	add 225
/-3- Ovenized Crystal (PM 9679E/01)	add 450
/-4- Very High Stability Ovenized Crystal (PM 9690/01)	add 645
/-5- Ultra High Stability Ovenized Crystal (PM 9691/01)	add 845
/-8- Standard Crystal plus Externally Referenced Frequency Multiplier (PM 9697/00)	add 175

Interface Option:

/--1 Standard Front Panel Control	N/C
/--2 Blind Panel Version with GPIB IEEE-488 I/F (PM 9696B/00)	consult factory
/--5 Standard Front Panel with Analog Recorder Output (PM 9695/00)	add 405
/--6 Standard Front Panel with GPIB IEEE-488 I/F (PM 9696B/00)	add 300
/--7 Standard Front Panel with GPIB IEEE-488 and MATE/CIIL Interfaces	add C/F

Example, Ordering Configuration

To order the 120 MHz, 100 ns resolution version with TCXO oscillator and standard front panel with GPIB IEEE-488 I/F, select:

		Model	Price
Configuration		PM 6652C	$2280
Option Suffix -	Input	/0--	N/C
	Oscillator	/-2-	225
	Interface	/--6	300
Yields Complete Model Number		PM 6652C/026	2805

Options and Accessories

PM 9610/01 1.5 GHz Option (input C)	$695
PM 9611/01 Built-in Rear Panel Input Wiring Option	90
PM 9612/01 Fan	229
PM 9613/01 Rack-Mount Slide Kit	175
PM 9678B/01 TCXO Time Base Oscillator (version/.2.)	225
PM 9679E/01 Ovenized Time Base Oscillator (version/.3.)	450
PM 9690/01 Ovenized Time Base Oscillator (version/.4.)	645
PM 9691/01 Ovenized Time Base Oscillator (version/.5.)	845
PM 9695/00 Analog Recorder Output	405
PM 9696B/00 IEEE-488 Bus Interface	300
PM 9697/00 External Reference Frequency Multiplier	175
PM 9585/01 50Ω Feed-Through Termination; 1W	30
PM 9665B/01 50 kHz Low Pass Filter	35
PM 9666/01 Trigger Level Output Cable	75

The time base oscillators PM 9678 to PM 9691 can also be ordered separately for later upgrading of the counters.

The PM 9611 option is not customer retrofittable, but must be ordered factory installed. The PM 9697 multiplier can be installed only in the /-1- versions.

Older versions of bus interface, PM 9696 (without "RTL-update"), cannot be used in a PM 6652C or PM 6654C.

Service & Support

Warranty

One-year product warranty. See Page 470 for further information on warranty terms and conditions.

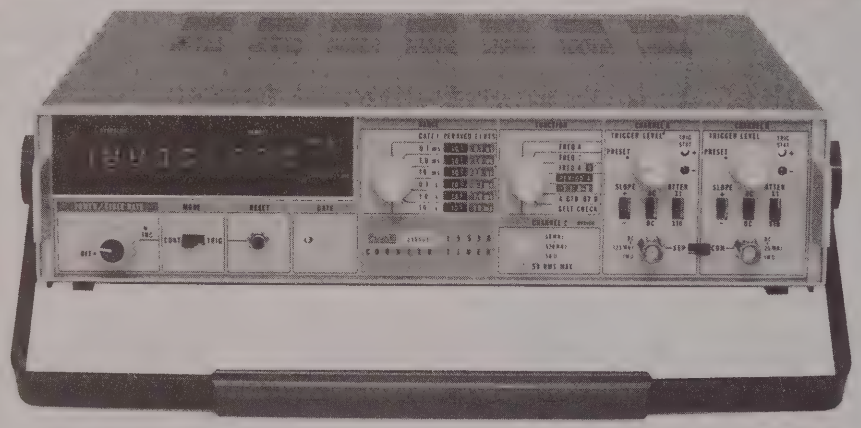
Note: The above configurations meet North American power requirements. For other power options, see page 491.

Crystal Oscillator Summary

PM 66../...Version Including Time Base Option	**/.1. Standard Version**	**/.2. Version PM 9678**	**/.3. Version PM 9679**	**/.4. Version PM 9690**	**/.5.Version PM 9691**
Stability Against	Standard	TCXO	Oven	Oven	Oven
Aging:/24h /Month /Year	N/A $<5 \times 10^{-7}$ $<5 \times 1^{-6}$	N/A $<1 \times 10^{-7}$ $<5 \times 10^{-7}$	N/A $<1 \times 10^{-7}$ $<5 \times 10^{-7}$	$<1.5 \times 10^{-9*}$ $<3 \times 10^{-8}$ <1.5 x 10-7	$<5 \times 10^{-10*}$ $<1 \times 10^{-8}$ $<7.5 \times 10^{-8}$
Temperature: 0°C to 50°C Ref. to +23°C	$<1 \times 10^{-5}$	$<1 \times 10^{-6}$	$<1 \times 10^{-7}$	$<3 \times 10^{-8}$	$<5 \times 10^{-9}$
Change in supply Mode: line/int. battery /ext. DC 12V to 28V	$<3 \times 10^{-7}$	$<5 \times 10^{-8}$	$<1 \times 10^{-8}$	$<3 \times 10^{-9}$	$<3 \times 10^{-9}$
Line Voltage:±10%	$<1 \times 10^{-8}$	$<1 \times 10^{-9}$	$<1 \times 10^{-9}$	$<5 \times 10^{-10}$	$<5 \times 10^{-10}$
Warm-up time to reach 10^{-7} of final value	N/A	N/A	<10 min	<15 min	<15 min

**After 48 Hours of continuous operation.*

1953A



1953A

1953A Universal Counter/Timer

- Frequency to 125 MHz (optional 520, 1000, 1250 MHz)
- Time interval measurements to 100 ns (single shot); 0.1 µs (averaged)
- Gated totalizing, frequency ratio and period measurements
- Fully GPIB/IEEE-488 programmable, including trigger levels
- 9 digit display

The 1953A is a systems counter with a wide array of options allowing you to select just the capability you need.

The 1953A can provide a variety of measurements: frequency, frequency ratio, period, period averaging, time interval, and gated totalizing. Trigger level controls allow selection of a preset level (0V dc), or adjustment to suit conditions. DMM output jacks and LED status indicators help the user to set the trigger levels properly.

Signal conditioning switches permit the operator to select positive or negative slope trigger, ac or dc coupling, and X1 or X10 attenuation. A marker output is provided for use with an oscilloscope for accurate determination of trigger points.

The GPIB/IEEE-488* interface option allows full programming of function, range, and signal conditioning, including trigger levels. Data output includes 9 digits of display information, decimal point, and exponent. Front panel lockout is provided. TTL level parallel remote programming and digital output options are also available.

Specifications

Technical Specifications

Frequency Measurements

Range: 0 to 125 MHz (dc coupled); 5 Hz to 125 MHz (ac coupled)
Gate Time: 0.1 ms to 10s in 6 decade steps
Resolution: 1/gate time (in Hz)

Period Measurements

Range: 0 to 25 MHz (dc coupled); 5 Hz to 25 MHz (ac coupled)
Periods Averaged: 1 period to 10^5 in decade steps
Resolution: 10^{-7}/periods

Time Interval Measurements

Range: 0.1 µs to 10^7s
Input: Channels A and B, common or separate
Resolution: 10 ms to 0.1 µs in 6 decade steps

Totalize Measurements

Range: 0 to 125 MHz (dc coupled); 5 Hz to 125 MHz (ac coupled)

Ratio Measurements

Display: Ch A/Ch B
Range:
Ch A: 0 to 125 MHz (dc coupled); 5 Hz to 125 MHz (ac coupled)
Ch B: 0 to 25 MHz (dc coupled); 5 Hz to 25 MHz (ac coupled)

Sensitivity

Channel A: 30 mV rms sinewave to 75 MHz, increasing to 50 mV at 125 MHz; 100 mV pulse amplitude with minimum pulse width of 10 ns
Channel B: 30 mV rms sinewave to 25 MHz; 100 mV with minimum pulse width of 50 ns
Channel C:
520 MHz Channel C Input (-07)
Covers frequency range of 50 to 520 MHz, using a scaling ratio of 4. Sensitivity is 15 mV rms (AGC). Maximum allowable input is 5V rms (fuse protected). VSWR less than 2:1 into 508 for levels less than 1V rms
1000 MHz Channel C Input (-13)
Covers 50 to 1000 MHz using a scaling ratio of 8. Sensitivity is 15 mV rms, and maximum allowable input is 5V rms (fuse protected). VSWR is less than 2.5:1 for levels less than 1V rms
1250 MHz Channel C Input (-14)
Covers 50 to 1250 MHz using a scaling ratio of 8. Sensitivity is 15 mV to 1000 MHz, decreasing to 30 mV rms at 1250 MHz. Maximum input is 5V rms (fuse protected). VSWR is less than 2.5:1 (508) for levels less than 1V rms

Input Impedance

Channel A or B: 1 MΩ ≤30 pF
Channel C: 50Ω nominal

Rear Panel Signals

External Timebase: 10 MHz, 250 mV to 8V
Gate Time: High True, TTL level output
Time Interval Marker: Low True, TTL level output
Trigger Level Output: Channels A & B only

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Timebases

	Standard	-04 Option	-10 Option	-20 Option
Frequency	10.00 MHz	10.00 MHz	10.00 MHz	10.00 MHz
Aging Rate (Constant Temp)	±3 x 10^{-7}/mo 1 ppm/yr	±3 x 10^{-7}/mo 1 ppm/yr	±1 x 10^{-7}/mo	±1.5 x 10^{-8}/mo
Temp Accuracy 0°C-50°C	±2 x 10^{-6}	±5 x 10^{-7}	±1 x 10^{-8}	<7 x 10^{-9}†
Line Voltage (±10%)	±2 x 10^{-8}	±2 x 10^{-8}	±3 x 10^{-9}	±1 x 10^{-9}

†Peak-to-peak variation

General Specifications

Temperature: 0°C to 50°C, operating; -40°C to +75°C, non-operating

Power: 115 or 230V ac ±10% (100V available), 50 to 400 Hz, 30W nominal

Size: 8.8 cm H x 36.2 W x 34.3 cm D (3.45 in H x 14.25 in W x 13.5 in D)

Weight: 4.32 kg (9.5 lb)

Ordering Information

Models

January 1989 prices

1953A Universal Counter/Timer	$1995
1953A-12 w/ Option -12 Installed	2555
1953A-15* w/Option -15 Installed	2550

**Not compatible with Option -02 or -11*

Options

-02 Digital Output Unit	$300
-04**Superior TCXO	285
-05 Timebase Multiplier	125
-07* 520 MHz	575
-10** Oven-Stabilized Timebase	475
-11** Basic Remote Programming	400
-13* 1000 MHz	725
-14* 1250 MHz	925
-16** Rear Inputs (Channels A,B,C)	95
-20** Superior Oven-Stabilized Timebase	950

** Factory or Service Center installation only. Options -04, -10, and -20 are mutually exclusive in one mainframe.*

*** Factory installation only*

Accessories (Also see page 485)

A53 Whip Antenna	$30
Y7201 Attenuator/Filter	65
M00-200-622 3" Rack Adapter	65
M00-200-626 3" Rack Adapter w/slides, for DEC cabinets	135
Y7206 3" Adapter w/slides, for non-DEC cabinets	120
Y8021 1m Cable, IEEE-488 bus	130
Y8022 2m Cable, IEEE-488 bus	145
Y8023 4m Cable, IEEE-488 bus	155
Y9103 50Ω BNC Feed-thru Terminator	35
Y9111 3 ft (0.93m) Coaxial Cable 50Ω, BNC to BNC	20
Y9112 6 ft (1.85m) Coaxial Cable 50Ω, BNC to BNC	20

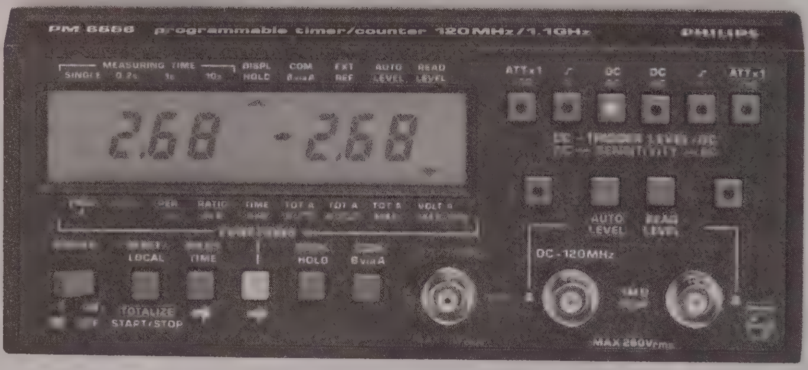
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

PM 6665 & PM 6666

GPIB
IEEE-488



PM 6666

PM 6665/PM 6666 Programmable Timer/Counters
Unrivalled price/performance
High resolution reciprocal counting
High trigger accuracy
PM 6666: Full GPIB/IEEE-488 programmability, Auto Trigger, Voltage Measurements
PM 6665: Continuously variable sensitivity, HF filter
High stability MTCXO: 2×10^{-7} over 0...50°C - push button calibration
9 measuring modes including high resolution time-interval average
1.3 GHz RF-Input

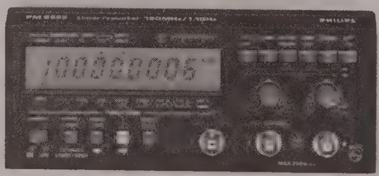
Introduction

The PM 6665 and PM 6666 are very versatile timer/counters with many functions included as standard, spanning frequencies from 0.1 Hz to 120 MHz, and optionally up to 1.3 GHz. The measuring functions include FREQUENCY, PERIOD, FREQ RATIO, TOTALIZE pulses, TIME INTERVAL, RPM (PM 6665) and VOLT peak values (PM 6666).

The units have a built-in microprocessor that uses the reciprocal frequency counting technique, which yields high resolution measuring results under all conditions, even on low frequency measurements.

Measuring accuracy is increased by the high performance counter front-ends, providing variable sensitivity and noise immunity. Accuracy can be further improved with the optional high stability time-base.

Both units provide unmatched value for money and offer a high degree of programmability through the GPIB/IEEE-488* interface. All major functions can be programmed with the PM 6665; and the PM 6666 offers 100% programmability including trigger level and sensitivity settings.



PM 6665

PM 6665

The PM 6665 timer/counter is specifically designed for applications with a small budget but a demand for a broad range of high performance counting and timing. It is low cost and offers the same high quality as other Philips test and measurement instruments. For example:

- Design is highly integrated, ensuring reliable, low power operation
- Stability is exceptional with Philips' MTCXO temperature compensated crystal oscillator, which delivers stability comparable to that of costly oven stabilized oscillators at the price level of a conventional TCXO
- An all-metal cabinet gives excellent RFI shielding and mechanical stability
- PM 6665 offers the best solution for both frequency and time measurements with its high quality inputs. Frequency measurements have continuously variable sensitivity and noise immunity and time measurements can be triggered within a wide ±5V/±50V range. A noise rejection filter is included as standard.

Optimal Time Measurements

The inputs for time measurements in the PM 6665 incorporate high speed synchronizers and equalized input channels to eliminate differences in delay and risetime. High sensitivity inputs reduce the possibility of trigger errors; trigger levels can be selected in the range from -50 to +50V and trigger indicators simplify level setting.

Frequency Measurements

Frequency measurements must have a variable noise immunity – which in practice means variable sensitivity – for correct triggering. On the PM 6665 this is accomplished with the continuously variable x1 ... x100 input signal attenuator.

Noise Rejection Filter Standard

The built-in noise rejection filter is useful for cleaning up noisy LF signals and for filtering off HF noise, even at levels higher than the input signal.

PM 6666

The PM 6666 is the first low cost timer/counter with high accuracy frequency, time and voltage measurements that also offers 100% programmable GPIB operation. With the GPIB bus, all measurement functions including trigger level settings and sensitivity can be programmed. A bus learn mode is provided to speed and simplify programming.

The PM 6666 is also an excellent all-purpose instrument for bench-top use, with 9 front panel selectable measuring functions including voltage max./min. measurements.

Time-out and separator settings are also programmable on both the PM 6665 and PM 6666 and a high speed mode delivers high-speed output of unformatted data at over 100 measurements/s. An optional rack mount adapter is available for both units for integration into measuring systems.

Error-Free Triggering

Triggering is error-free on the PM 6666 for all waveforms. Trigger-level setting can be automatic on all input signals over 100 Hz. Resolution

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** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

is 20/200 mV, over a very wide range (-50 ... +50V) that allows measurements to be accurate even on high voltage events. The trigger level can be displayed immediately with one keystroke; and inputs can be instantly checked for triggering with the tri-state LED trigger indicators.

To give the various noise immunity settings, input sensitivity has six steps, from 20 mV to 1 Vrms .

Peak Voltage Measurements to 50 MHz

The PM 6666 has a unique capability for an instrument in this price range, i.e. Vpeak measurements (-50...+50V) at up to 12 MHz at an error level of no more than a few percent. Vpeak measurements are possible over the range 12...50 MHz with slightly higher errors. When displaying Vmax./min. measurements, positive and negative signal peaks of the input signal are shown simultaneously with a resolution of 20/200 mV.

PM 6665 & PM 6666; Leading Technology

The latest technology is used in these timer/counters to give them their unrivalled performance for instruments in their price class.

Special emphasis was placed on reliability and integration to decrease the component count, which reduces heat dissipation and gives a high MTBF figure. For example, the entire counting logic circuitry consists of just two chips – the LSI counter-on-a-chip and a single chip control microcomputer. Also, a unique crystal oscillator is used for the timebase facilities – the MTCXO (see below). All this combines to give very powerful instruments in a small package and low price.

The PM 6665 and PM 6666 have high input protection, allowing them to withstand inputs of 12 Vrms on the optional 50 ohm RF input, and 350V (dc + ac peak) on the 1 Mohm LF input.

Unique MTCXO Timebase

Until now, choice of the timebase crystal oscillator, which determines the final accuracy of the counter, was only between the low-cost uncompensated standard crystal oscillators, medium price TCXOs (temperature compensated crystal oscillators) and high price, high stability oven-controlled oscillators.

Now, Philips has developed a mathematically compensated crystal oscillator which costs the same as a normal TCXO yet has a stability of 2×10^{-7} (0...50°C), comparable with that of an oven stabilized oscillator.

This new oscillator is called the MTCXO or Mathematically Temperature-Compensated Crystal Oscillator. It has an associated non-volatile memory in which are stored the frequency deviations from the factory measured temperature dependent frequency curve, at each temperature. During a measurement, the temperature of the crystal is measured, the deviation for that temperature is retrieved from the memory and the result is automatically compensated before display. In addition, because the temperature of the crystal is always compensated for each measurement, no warm up time is required for high accuracy measurement. Calibration is performed with the touch of a button, without warm-up.

High Resolution

Both PM 6665 and PM 6666 can measure low frequency signals to high resolution with synchronized multiple period measurements and computing the reciprocal values.

Resolution is at least 7-digits on a 1s measuring time, because the traditional ±1 input cycle error is eliminated by the built-in microprocessor. This high resolution applies to all input frequencies, whether high or low. Thus long gate times are no longer needed to obtain high resolution when measuring low frequency input signals. There is also no risk of instrument rounding error, because of the full 9-digit display.

Time interval measurements are high resolution as well as high accuracy, due to the time interval averaging technique. The 100 ns resolution is improved by a factor $\sqrt{N}$ (N + number of time intervals averaged) when compared with single time interval measurements. The maximum obtainable N is 4×10^7, resulting in a resolution of better than 20 ps.

Versatility for All-Purpose Use

Several variations and options are available so the user can chose exactly the configuration required for his application. The options are factory installed and tested in each user configuration. However, all options can also be field installed by the user allowing upgrading of the counter at any time.

The full range comprises:

- GPIB interface
- Highly stabilized timebase (MTCXO)
- 1.3 GHz HF input
- Battery power pack
- Rack mount kit
- Carrying case

Specifications

Measuring Functions

Frequency A or C (frequency B via GPIB only)

Range:
Freq A: 0.1 Hz...120 MHz: typically...160 MHz
Freq B: 0.1 Hz...12 MHz (via GPIB only)
Freq C: 70 MHz...1.3 GHz (optional)
Mode: Reciprocal frequency counting
LSD Displayed:

$$\frac{2.5 \times 10^{-7} \times \text{FREQ}}{\text{measuring time}}$$

RPM A (PM 6665 only)

A FREQUENCY A measurement is taken, multiplied by 60 and shown on the display as revolutions per minute (RPM).
Range: 6 RPM...720 x 10^6RPM

Period A

Range: 8 ns...2 x 10^8s
Mode: Single period measurement (SINGLE) or average period measurement (at 0.2, 1 or 10s measuring times)
LSD Displayed:
SINGLE period measurement: 100 ns (TIME <100s)
Average period measurement:

$$\frac{2.5 \times 10^{-7} \times \text{PERIOD}}{\text{measuring time}}$$

Ratio A/B (ratio B/A, C/A or C/B via GPIB only)

Range: 1 x 10^{-7}...2 x 10^9 (A/B);
1 x 10^{-8}...2 x 10^8 (B/A);
0...1 x 10^{15} (A/B SINGLE and B/A SINGLE);
8...6 x 10^{10} (C/A, C/B)
Frequency Range:
Input A: 0...120 MHz (A/B); 0...12 MHz (B/A, C/A, A/B SINGLE)
Input B: 0...12 MHz
Input C: 70 MHz...1.3 GHz

Time Interval A-B (time interval B-A via GPIB only)

Range: 100 ns...2 x 10^8s (SINGLE);
0 ns...20 s (average)
Mode: Single time interval (SINGLE) or average time interval measurements (at 0.2, 1 or 10s measuring times)
LSD Displayed:
SINGLE time interval measurements: 100 ns (TIME <100s)
Average time interval measurements:

$$\frac{2.5 \times 10^{-7}\text{s}}{N}$$

Averaged Number of Intervals N:

$$\frac{\text{measuring time}}{\text{pulse repetition time}}$$

Note: Input signals must be repetitive and asynchronous with respect to the time base.

Min Dead Time from Stop to Start: 250 ns
Timing Difference A-B Channels: 4 ns max.

Totalize A (totalize B via GPIB only)

Range: 0...1 x 10^{15} with indication of K or M (Kilopulses or Megapulses). The result is truncated if out of display range.
Frequency Range: 0 Hz...12 MHz
Pulse Pair Resolution: 80 ns
Gated by B (A) Mode: Event counting on input A (B) during the duration of a pulse on input B (A).
Start/Stop by B (A) Mode: Event counting on input A (B) between two consecutive pulses on input B (A).

PM 6665 & PM 6666

Manual Mode: Event counting controlled by the START/STOP button. Sequential start-stop counts are accumulated. RESET closes the gate and resets the timer/counter to zero.

Volt Max./Min. A, PM 6666 only (volt max./min. B via GPIB only)

Range: -51V...+51V
Frequency Range: DC and 100 Hz...50 MHz (input A);
DC and 100 Hz...5 MHz (input B)
Resolution:
Input signals within ±5V: 20 mV
Input signals outside ±5V: 200 mV
Inaccuracy DC and 100 Hz...12 MHz (A), or ...1 MHz (B):
Input signals within ±5V: 30 mV ±1% of reading ±3% of V_{pp}
Input signals outside ±5V: 300 mV ±3% of reading ±3% of V_{pp}
Inaccuracy 12 MHz...50 MHz (A) or 1 MHz... 5 MHz (B):
Input signals within ±5V: 30 mV ±10% of reading ±10% of V_{pp}
Input signals outside ±5V: 300 mV ±10% of reading ±10% of V_{pp}

Definitions

LSD Displayed

LSD = unit value of the least significant digit displayed. All calculated LSDs (see measuring functions section) should be rounded to the nearest decade (e.g. 0.3 Hz is rounded to 0.1 Hz and 5 Hz to 10 Hz) and cannot exceed the 9th digit.

Resolution

Resolution = smallest increment between two measuring results on the display, due to the ±1 count error.

Freq A, Freq C, Period A: Resolution can be 1 or 2 LSD if:

$$\frac{\text{LSD x measuring time}}{\text{FREQ or PERIOD}} < 10^{-7},$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).

Ratio A/B: Resolution can be 1 or 2 LSD. If:

$$\frac{\text{LSD x measuring time}}{\text{RATIO}} < \frac{10}{\text{FREQ A}}$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).

SINGLE Period A and SINGLE Ratio A/B: Resolution is 1 LSD

Time A-B: Resolution (95% confidence) = 1 LSD or 100 ns/√N, whichever is greater

Inaccuracy

Inaccuracy, i.e. the relative error, depends on the following factors:

$$\pm \frac{\text{Resolution}}{\text{FREQ, PERIOD RATIO or TIME}} \pm \text{relative trigger error}$$

± relative time base error
± relative systematic error

Relative Trigger Error:

Freq A, period A:

$$\pm \frac{\text{noise voltage A (Vpp)}}{\text{signal slope A (V/s) x meas. time}}$$

Ratio A/B:

$$\pm \frac{\text{noise voltage B (Vpp)}}{\text{signal slope B (V/s) x meas. time}}$$

Totalize A gated or start/stop by B:

$$\pm \frac{\text{noise voltage B (Vpp)}}{\text{signal slope B (V/s) x gate time B}}$$

Time A-B:

$$\pm \frac{\text{noise voltage A (Vpp)}}{\text{signal slope A (V/s) x TIME x}\sqrt{\text{N}}}$$

$$\pm \frac{\text{noise voltage B (Vpp)}}{\text{signal slope B (V/s) x TIME x}\sqrt{\text{N}}}$$

Relative Time Base Error:

$$\pm \frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$$

Relative Time A-B Systematic Error:
Inaccuracy caused by timing difference between A and B channels <±4 ns/TIME

Input Specifications

Input-A and Input-B; PM 6665 only

Frequency Range:
DC-coupled: DC...120 MHz
AC-coupled: 20 Hz...120 MHz
Minimum Pulse Duration: 4 ns
Coupling: AC or DC
Impedance: 1 MΩ//35 pF
Channel Input: Separate A and B, or common via A
Maximum Voltage Without Damage: 350V (DC + ACpk) between 0 and 440 Hz, falling to 8 Vrms at 1 MHz.
Sensitivity; DC Coupled:
Sine: 20 mVrms, 0 Hz...100 MHz;
30 mVrms, 100 MHz...120 MHz
Pulse: 60 mVpp, 0 Hz...100 MHz;
90 mVpp, 100 MHz...120 MHz
Sensitivity decreases to 60 mVrms at 160 MHz typically
Sensitivity; AC Coupled:
Sine: 20 mVrms...200 mVrms at 20 Hz...100 MHz; 30 mVrms...300 mVrms at 100 MHz...120 MHz, continuously variable
Sensitivity decreases to 60 mVrms at 160 MHz typically
Filter: Switchable 50 kHz low pass noise filter with approx. 40 dB suppression at 1 MHz
Attenuation: x1 or x10
Trigger Slopes: Positive or negative
Trigger Level Range:
DC-coupled: +5V...-5V (x1); -50V...+50V (x10)
AC-coupled: 0V fixed
Trigger Indicators: Indication on LCD display when triggering on inputs A or B occurs.

Input-A and Input-B; PM 6666 only

Frequency Range:
DC-coupled: DC...120 MHz
AC-coupled: 20 Hz...120 MHz
Minimum Pulse Duration: 4 ns
Coupling: AC or DC
Impedance: 1 MΩ//35 pF
Channel Input: Separate A and B, or common via A
Maximum Voltage Without Damage: 350V (DC + ACpk) between 0 and 440 Hz, falling to 8 Vrms at 1 MHz
Sensitivity; DC Coupled:
Sine: 20 mVrms, 0 Hz...30 MHz;
40 mVrms, 30 MHz...120 MHz
Pulse: 60 mVpp, 0 Hz...30 MHz;
110 mVpp, 30 Hz...120 MHz
Sensitivity decreases to 60 mVrms at 160 MHz typically
Sensitivity; AC Coupled: Sensitivity is selectable in 6 steps; 20 mV, 50 mV, 100 mV, 200 mV, 500 mV and 1 Vrms (sine); nominal
Maximum sensitivity: 20 mVrms at 20 Hz...30 MHz; 40 mVrms at 30 MHz...120 MHz
Sensitivity decreases to 60 mVrms at 160 MHz typically
Attenuation: x1 or x10, switch selectable or AUTO
Trigger Slopes: Positive or negative
Trigger Level Range:
DC-coupled: -51V...+51V, adjustable via up/down control or AUTO
AC-coupled: 0V fixed or AUTO level
Trigger Level Resolution: 20 mV; signals within ±5V
200 mV; signals above ±5V
Trigger Level Setting Accuracy: ±10 mV ±1% of setting
AUTO Trigger Level: Trigger Level on input A (and B when required) is automatically set to 50% of input signal amplitude.
Frequency range: 100 Hz...120 MHz
Trigger Indicators: Tri-state LED indicators

Input C (Option PM 9608B)

Frequency Range: 70 MHz...1.3 GHz
Coupling: AC
Operating Input Voltage Range:
10 mVrms...12 Vrms, 70...900 MHz;
15 mVrms...12 Vrms, 900 ...1100 MHz;
40 mVrms...12Vrms, 1100...1300 MHz
AM Tolerance: 94% at max. 100 kHz modulation frequency; minimum signal must exceed minimum operating input voltage requirement
Input Impedance: 50Ω nominal, VSWR <2:1
Max. Voltage Without Damage: 12 Vrms, overload protection with pin diodes.

PM 6665 & PM 6666

External Reference Input

Input Frequency: 10 MHz ±0.1 MHz
Coupling: AC
Sensitivity: 500 mVrms
Input Impedance: Approx. 300Ω at 10 MHz
Maximum Input Voltage: 15 Vrms

General Specifications

Power Requirements

Line Voltage: 115 or 230 Vrms ±15%; 46...440 Hz, <22 VA (PM 6665) resp. <24 VA (PM 6666) incl. all options
Safety: In accordance with IEC 348 Class I and CSA 556B
Line Interference: Below VDE 0871 B and MIL STD 461
Battery Unit: See PM 9605 option

Timebase

Oscillator version:	Standard	MTCXO
Stability against:		
Aging		
per month	$<5x10^{-7}$	$<1x10^{-7}$
per year	$<5x10^{-6}$	$<5x10^{-7}$
Temperature changes 0...50°C	$<1x10^{-5}$	$<2x10^{-7}$
Line Voltage changes 10%	$<1x10^{-8}$	$<1x10^{-9}$

Display

Read Out: 9 digit LCD with unit and cursor indication
GATE Indicator: Indicates that the counter is measuring
REMOTE Indicator: Indicates when the counter is remotely controlled via an installed GPIB interface (PM 9604)

Environmental Conditions

Temperature:
Operating: 0°C...+50°
Storage: -40°C...+70°

Altitude:
Operating: 5000m (53.3 kN/m²)
Storage: 15000m (15.2 kN/m²)

Humidity:
Operating: 10%...90% RH, no condensation
Storage: 5%...95% RH

Dimensions and Weight

Dimensions: 186 mm W x 88 mm H x 270 mm L (7.3 in W x 3.5 in H x 10.6 in L)
Weight: 2.1 kg (4.6 lb)

Auxiliary Functions

RESET

The RESET button has three functions:
RESET: starts a new measurement. The settings are not changed.
LOCAL: makes the counter go to LOCAL operation, when in remote operation (unless Local Lock-Out is programmed).
START/STOP: opens/closes the gate in TOTALIZE A, manual mode.

Measuring Time

A measuring time of 0.2s, 1s, 10s or SINGLE can be selected

Display Hold

The current measuring result is frozen on the display. A new measurement starts when the RESET button is pressed.

Optional Accessories

GPIB Interface, PM 9604

Mounting: Inside counter cabinet
Interface Functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2
Programmable Device Functions:
Measuring functions
Measuring time
Trigger slope
Trigger levels (PM 6666)
Sensitivity (PM 6666)
Input coupling (PM 6666)
Input attenuator (PM 6666)
Manual totalize gate control
Output separator selection
Device clear
Device trigger
High speed dump
Short output format
Set time-out
Free run/triggered measurements
Set SRQ-mask
Program data out
Device identity
Max. Data Output Rate:
Normal Mode: Approx. 5 readings/s
High Speed Dump: Approx. 100 readings/s
The highest output rate is obtained at SINGLE measuring time.
High Speed Dump: The contents of the counting registers are transferred to the controller, without being processed by the counter. The processing must be done in the controller instead.
Output Time for Measuring Data:
Normal Mode: Approx. 9 ms (20 bytes)
High Speed Mode: Approx. 4 ms (15 bytes)
Response Time for Addressing: Approx. 1 µs
Response Time for Trigger Command (GET): Approx. 10 ms
Typical Read Time for Programming Data: Approx. 1 ms/byte

Battery Unit PM 9605

The PM 9605 is a rechargeable battery unit for mounting inside the counter. The unit contains a standard 6V sealed lead-acid battery and an automatic battery charger.

Battery Capacity (20°C): Approx. 15 Wh
Operating Time when Battery Powered: Approx. 2 hours of continuous operation
Recharging Time: 5 hours to approx. 75% of full capacity
Battery Protection: Overcharge protection and deep discharge (auto shut off) protection
Temperature:
Operating: 0...+40°C
Storage: -40...+50°C
Weight: 0.8 kg (1.7 lb)

Rack-Mount Kit HM 9606

The HM 9606 rack kit is designed for use with the PM 6665/6/9 family of counters. The HM 9606/01 allows mounting of one counter on the left of the rack and a blank panel on the right. The HM 9606/00 allows mounting of one counter plus one Fluke model 8840/2 or Philips PM 2534 or PM 2535 DMMs. The HM 9606 requires 5-1/4 inches of rack space. (See photo page 358.)

Carrying Case PM 9609

Included with the Instrument: Operating Manual, line cord

Ordering Information

Models

January 1989 prices

PM 6665 Timer/Counter	$895
PM 6666 Timer/Counter	995

Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit/suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface

Input Frequency Option:

/0-- Standard 120 MHz	N/C
/4-- 1.3 GHz (PM 9608B/00)	add 310

Reference Oscillator Option:

/-1- Standard	N/C
/-3- MTCXO (PM 9607/00)	add 240

Interface Option:

/--1 Standard line voltage, non GPIB IEEE-488	N/C
/--3 Battery (PM 9605/00)	add 245
/--6 GPIB IEEE-488 (PM 9604/00)	add 295

Example, Ordering Configurating
To order the PM 6666 with standard 120 MHz input, MTCXO Oscillator, and standard interface, select:

			Price
Model		PM 6666	$995
Configuration			
Option Suffix - Input		/0--	N/C
	Oscillator	/-3-	240
	Interface	/--1	N/C
Yields Complete Model Number		PM 6666/031	1235

PM 6665 & PM 6666

Options and Accessories

PM 9604/00* GPIB Interface	$295
PM 9605/00* Battery Unit	245
HM 9606/00 Rack Kit for PM 6665/6 and 8840/2 or PM 2534/35 DMMs	95
HM 9606/01 Rack Kit for PM 6665/6	90
PM 9607/00 MTCXO Timebase	240
PM 9608B/00 1.3 GHz HF-Input	$310
PM 9609 Carrying Case	75
PM 9581/01 50Ω Termination 3W	65
PM 9585/01 50Ω Termination 1W	30

All options can be field installed by the user.

** The GPIB interface PM 9604 and the battery unit PM 9605 cannot be installed together in a PM 6665/66 counter.*

Service and Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

7200 Series

7200 Series Counters

- Frequency measurement to 1300 MHz
- Single-shot time intervals to 10 ns
- Autoranging resolution for simple operation
- 100 kHz low-pass filter
- Fully EMI shielded
- Ovenized accuracy with battery portability

The 7200 Series consists of four counters, capable of measuring frequencies up to 1300 MHz, packaged in the versatile Portable Test Instrument case.

The 7220A Communications Counter provides frequency measurements to 1300 MHz. The 7250A Universal Counter/Timer is the lowest priced member of the family, and offers frequency, period, time interval, and totalizing measurements up to 80 MHz. The 7260A offers these same features, plus trigger hold-off and an optional Channel C for frequency measurements to 1300 MHz. The top-of-the-line 7261A adds increased resolution through a 100 MHz timebase, and offers a phase modulated time base to ensure valid time interval averaging of clock-synchronous signals.

The PTI Concept

The Fluke-developed Portable Test Instrument (PTI) packaging concept allows you to easily configure low-cost, convenient mini-test systems using the Fluke 1120A IEEE-488 Translator. A number of compatible Fluke instruments can be interfaced using the 1120A, including counters and voltmeters. With the 1120A, any PTI instrument cluster may be operated in a GPIB/IEEE-488* system. The unique stack-and-latch design makes them easy to carry; requires less rack space, too.

Low Susceptibility, Minimal rf Radiation

A lightweight, interval stainless steel shield completely surrounds the instruments and mates with the metal front and rear panels to provide an rf enclosure meeting most requirements of MIL-STD-461. This means low susceptability in high rf environments, as well as minimal radiated energy to interfere with nearby rf-sensitive equipment.

Portable Counters With Ovenized Accuracy

For applications demanding the best possible accuracy, ovenized timebase oscillators are available. These oscillators consume such low power they can be used when the counters are operating from batteries. When you go out on a field assignment you can switch to battery power and keep the oscillator warm and standing by for instantaneous use with laboratory stability and accuracy. There are two oven options to choose from, one with an accuracy of ±1 x 10^7, and one with an accuracy of ±3 x 10^8 over the 0°C to 40°C temperature range.

Simple, Hands-Off Operation

All counter/timer models (7250A, 7260A, 7261A) feature AUTO ranging resolution. Simply select the desired measurement function, set the resolution switch to AUTO range, and the instrument will automatically choose the correct range for best resolution, position the decimal point properly, and light an annunciator LED indicating the units of measurement.

7220 Communications Counter

The 7220A gives you 10 Hz to 1300 MHz coverage via two separate channels. Channel A is for low-frequency applications (10 Hz to 125 MHz), where the loading of the signal source and the effects of high frequency noise must be minimized. Channel B has a 50 ohm input and is for signals from 100 MHz to 1300 MHz.

An ac-coupled, 1 megohm input and versatile front-end controls for Channel A let you measure signals having extremely high noise levels and still produce stable, accurate readings. A continuously variable X1 to X10 wideband at tenuator plus switchable 1X or 10X attenuation lets you minimize noise without losing the signal. And a switchable 100 kHz low-pass filter solves the problem of high frequency contamination of audio frequencies. Used together, the attenuator and filter can solve most noise problems.

The resolution multiplier (Option -351) in creases measurement resolution by a factor of 1000 for frequencies from 10 Hz to 10 kHz with out requiring any more measurement time. Resolution goes from 0.001 Hz for 10 Hz signals to 0.1 Hz for 10 kHz signals.

7250A Universal Counter/Timer

The 7250A measures frequencies to 80 MHz, time intervals down to 100 ns, and periods down to 100 ns with 1 ps resolution (in the average mode). In addition it will measure the ratio of two signal frequencies, counts per minute, or totalize events to 9,999,999 counts.

A broadband, continuously variable, x100, analog attenuator lets you add just enough at tenuation to minimize the input signal noise level and optimize the signal amplitude for count- ing. A switchable 100 kHz, lowpass filter solves the problem of high frequency contamination of audio signals. You can use the filter and attenuator separately or in combination to solve tough noise problems, like calibrating audio oscillators near high power rf transmitters. For timing measurements, there are ±slope controls, fixed-offset trigger level switches, and a separate/common switch at your fingertips.

7260A & 7261A Universal Counter/Timers

The 7260A and 7261A will measure frequencies to 125 MHz, or (optionally) to 520 MHz or 1300 MHz, with a 50Ω channel (Channel C).

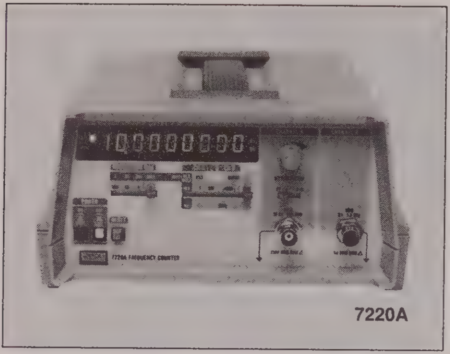
The instruments are essentially alike except the 7261A has a 100 MHz clock, with a corresponding basic resolution of 10 ns, and the 7260A has a 10 MHz clock, with 100 ns resolution. Both counters will amke time-interval or signal-period measurement and will average from 10^0 to 10^5 such measurements per reading when greater resolution or accuracy is desired. That extends the resolution of the 7261A to 31.6 ps for time-interval measurements or to 0.1 ps for period measurements. In addition, the 7261A is available with a unique phase-modulated timebase option to assure averaging out small consistent errors.

A broadband attenuator lets you select 1X, 10X or 100X attenuation to minimuze interference from signal noise and to trigger near the peak of high amplitude signals. And a switchable 100 kHz low-pass filter solves the problem of high frequency contamination of audio frequency signals. The signal may be dc coupled or ac coupled and weither + or - slope of the sign may be selected for triggering. The Channel A and Channel B trigger level controls have a zero-volt preset position for easy triggering on sinewaves and other signals that cross the zero-volt level.

Trigger status lights tell when triggering is unstable, and the precise trigger level setting of both channels may be monitored at a rear panel connector. Also at the rear panel is a marker output — a gate signal that brackets each period or time- interval measurement. The marker is for use with an oscilloscope. The trigger level and marker outputs are for making accurate timing measurements such as the rise time and fall time of complex signals. Atime interval hold-off control with a 1000:1 ratio (20 µs to 20 ms) delays the end of the marker gate to measure the precise protion of a signal.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

7200 Series


7220A

7220A Specifications

Frequency Measurements

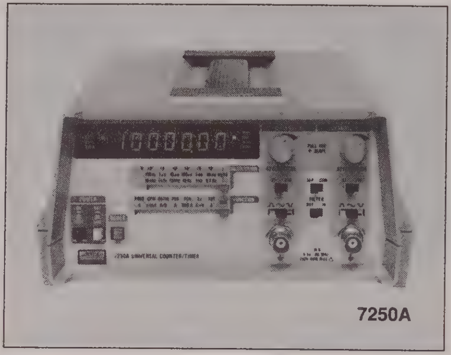
Channel A Range: 10 Hz to 125 MHz
Channel B Range: 100 MHz to 1300 MHz
Resolution: 0.1 Hz to 100 kHz in decade steps
Accuracy: ±1 count ± timebase error*
Display: MHz
Burst Mode: Minimum burst equals gate time +40 ms
**See Timebase Characteristics chart*

Channel A Input Characteristics

Bandwidth: 10 Hz to 125 MHz, ac-coupled
Sensitivity: 10 mV rms, 10 Hz to 50 MHz; 15 mV rms, 50 MHz to 100 MHz; 25 mV rms, 100 MHz to 125 MHz
Impedance: 1 MΩ, <60 pF
Filter: 100 kHz, low pass
Attenuator: X1 to X100; X1 or X10 fixed, plus X1 to X10 continuously variable
Maximum Input: 250V rms from 10 Hz to 5 kHz decreasing linearly from 250V rms at 5 kHz to 5V rms at 2 MHz; 5V rms from 2 MHz to 125 MHz

Channel B Input Characteristics

Bandwidth: 100 MHz to 1300 MHz
Sensitivity: 5 mV rms, 100 MHz to 600 MHz; 10 mV rms, 600 MHz to 1000 MHz; 40 mV rms, 1000 MHz to 1300 MHz
Impedance: 50Ω
VSWR: 2.5:1, maximum
Maximum Input: 5V rms


7250A

7250A Specifications

Frequency Measurements (CH A)

Range: 5 Hz to 80 MHz, ac coupled
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ±1 count ± timebase error*
**See Timebase Characteristics chart*

Period Measurements (CH A)

Range: 100 ns to 99,999.99 seconds
Frequency Range: 5 Hz to 1 MHz
Resolution: 10 ms to 100 ns in decade steps
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms, or sec with decimal

Period-Average Measurements (CH A)

Range: 1 ps to 999,999.9 µs
Frequency Range: 5 Hz to 1 MHz, sinewave
Resolution: 100 ns to 1 ps in decade steps
Accuracy: ±100 ns ÷ N* ± timebase error ± trigger error ÷ N*
Display: µs or ms with decimal
**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles of B averaged in ratio mode.*

Time-Interval Measurements (CH A/B)

Range: 100 ns to 99,999.99 sec
Frequency Range: 5 Hz to 1 MHz
Resolution: 100 ns to 10 ms in decade steps
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms or sec with decimal

Totalize

Range: 5 Hz to 80 MHz for channel A
Count Capacity: 9,999,999
Display: Digits only , no decimal or annunciator

Ratio Measurements

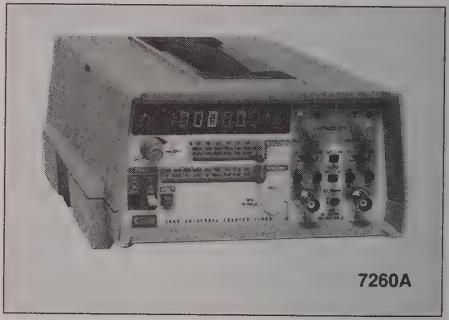
Range: 5 Hz to 80 MHz for channel A, 5 Hz to 1 MHz for Channel B
Resolution: ± frequency of B ÷ (N* x frequency of A)
Accuracy: ±Resolution ±(frequency of B x trigger error of B ÷ N*)
Display: Digits with decimal, no annunciator

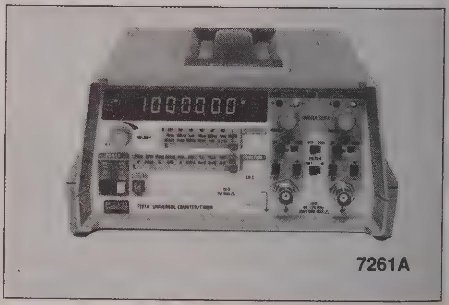
Counts Per Minute (cpm x 200,* CH A)

Range: 5 Hz to 80 MHz
Count Time: 600 ms (1/100 minute)
Resolution: 100 cpm, fixed
Accuracy: ± 1 count ± timebase error
Display: Digits only, no decimal or annunciator
**Reads RPM direct of 100-tooth wheel/sensor*

Channel A & B Input Characteristics

Selection: Separate or A connected to B (Sep/Com)
Sensitivity: 10 mV rms 5 Hz to 50 MHz, 15 mV rms, 50 MHz to 80 MHz
Impedance: 1 MΩ, 50 pF, nominal
Coupling: ac only
Attenuator: X 1 X 100, continuously variable
Filter: Low pass, 100 kHz 3 db point, nominal
Trigger Level: +150 mV, 0V, or -150 mV, 0V or -150 mV, switch-selectable
Maximum Input: 100V rms 5 Hz to 45 Hz, 250V rms 45 Hz to 50 kHz decreasing to 5V rms at 1 MHz to 80 MHz


7260A


7261A

7260A & 7261A Specifications

Technical Specifications

Frequency Measurements (Channel A)

Range: 0 Hz to 125 MHz
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ±1 count ± timebase error*
Display: kHz or MHz with decimal
**See Timebase Characteristics chart*

Frequency Measurements, Channel C Option (-310 or -331)

Range: 50 MHz to 520 MHz (Option -310); 100 MHz to 1300 MHz (Option -331)

Resolution: 0.1 Hz to 10 kHz, in decade steps

Accuracy: ±1 count ± timebase error*

Display: kHz or MHz with decimal

**See Timebase Characteristics chart*

Ratio Measurements (A/B)

Range: 0 Hz to 125 MHz for channel A, 0 Hz to 2 MHz for Channel B

Resolution: ± frequency of B ÷ N* x frequency of A

Accuracy: Resolution ± frequency of B x trigger error of B ÷ N*

Display: Decimal, no annunciator

Period Measurements (Channel A)

Range: 100 ns to 999,999.99 seconds for 7260A, or 10 ns to 99,999.999 seconds for 7261A

Frequency Range: 0 Hz to 2 MHz, sinewave

Pulse Width: ≥500 ns from 0 Hz to 100 kHz, ≥250 ns from 100 kHz to 2 MHz

Resolution: 10 ms to 100 ns in decade steps for 7260A, or 1 ms to 10 ns in decade steps for 7261A

Accuracy: ±1 count ± timebase error ± trigger error

Display: ms, or sec with decimal for 7260A, µs, ms, or sec with decimal for 7261A

Period-Averaged Measurements (CH A)

Range: 1 ps to 9,999,999.9 µs for 7260A; 0.1 ps to 999,999.99 µs for 7261A

Frequency Range: 0 Hz to 2 MHz, sinewave

Pulse Width: ≥500 ns from 0 Hz to 100 kHz, ≥250 ns from 100 kHz to 2 MHz

Resolution: 100 ns to 1 ps in decade steps for 7260A; 10 ns to 0.1 ps in decade steps for 7261A

Accuracy: 100 ns ÷ N* ± timebase error ± trigger error ÷ N* for 7260A, or 10 ns ÷ N* ± timebase error ± trigger error ÷ N* for 7261A

Display: µs or ms with decimal

**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles averaged in ratio mode.*

Time-Interval Measurements (CH A/CH B)

Range: 100 ns to 999,999.99 sec, for 7260A, or 10 ns to 99,999.999 sec 7261A

Frequency Range: 0 Hz to 5 MHz, sinewave

Pulse Width: 250 ns, for 7260A, 210 ns for 7261A

Resolution: 100 ns to 10 ms in decade steps for 7260A, 10 ns to 1 ms in decade steps for 7261A

Accuracy: ±1 count ± timebase error ± trigger error

Display: ms or sec 7260A; µs, ms, sec 7261A

Time Interval Holdoff: 20 µs to 20 ms, continuously variable

Time-Interval-Averaged Measurements (CH A/CH B)

Range: 1 ns to 9,999,999.9 +s for 7260A, or 0.1 ns to 999,999.99 µs for 7261A

Frequency Range: 0 Hz to 5 MHz, sinewave

Pulse Width: 250 ns for 7260A, 210 ns for 7261A

Resolution: 100 ns ÷ √N* for 7260A, 10 ns ÷ √N* for 7261

Accuracy: 100 ns ÷ √N* ±10 ns ± timebase error ± trigger error ÷ √N* for 7260A; 10 ns ÷ √N* ± timebase error ± trigger error ÷ √N* for 7261A

Dead Time: 4 µs

Display: µs or ms with decimal

**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles of B averaged in ratio mode.*

Totalize (CH A Gated by CH B)

Range: 0 Hz to 125 MHz for channel A, 0 Hz to 2 MHz for channel B

Count Capacity: 99,999,999

Display: Total count, no decimal or annunciator

Time Interval Holdoff: Range, 20 µs-20 ms, cont variable

Counts Per Minute (cpm x100, CH A)

Range: 0 Hz to 125 MHz

Count Time: 600 ms (1/100 minute)

Resolution: 100 cpm, fixed

Accuracy: ±1 count ± timebase error

Display: No decimal or annunciator

Channel A & B Input Characteristics

Bandwidth: 0-125 MHz, dc coupled; 5 Hz-125 MHz, ac coupled

Selection: Separate or A connected to B (Sep/Com)

Sensitivity: 10 mV rms, 0 to 50 MHz; 15 mV rms, 50 to 100 MHz; 35 mV rms, 100-125 MHz

Minimum Pulse: 50 ns at 50 mV pk (7260A); 10 ns at 50 mV pk (7261A)

Impedance: 1 MΩ, 50 pF, nominal

Coupling: ac or dc

Attenuator: X1, X10, X100, switchable

Slope: < or —, switchable

Filter: Low pass, 100 kHz 3 dB point, nominal

Trigger Level Range: +1.5V to -1.5V

Linear Operating Range: +2.5V to -2.5V

Maximum Input: 100V rms 0 Hz to 45 Hz, 250V rms 45 Hz to 50 kHz decreasing to 5V rms at 1 MHz, 5V rms 1 MHz to 125 MHz

Channel C Input Characteristics Option (-310 or -331)

Bandwidth: 50 MHz to 520 MHz (Option -310); 100 MHz to 1300 MHz (Option -331)

Sensitivity: 10 mV rms (Option -310); 5 mV rms to 600 MHz, 10 mV rms from 600 MHz to 1000 MHz, 40 mV rms from 1000 MHz to 1300 MHz (Option -331)

Impedance: 50Ω, 2.5: 1 VSWR, maximum

Maximum Input: 5V rms, fused

Triggering

Trigger Level Output: ±1.5V level indicates dc trigger level set on either Channel A or B, switch-selectable

Trigger Status Indicators: Two per channel provide positive indication that the input signal is triggering the input amplifier and relative in dication as to where on the signal the input amplifier is being triggered

Cont/Trig Mode: Rear panel switch activates external trigger mode for initiating a measurement

General Specifications

External Timebase Input

Frequency: 10 MHz, ac coupled

Sensitivity: 300 mV rms

Impedance: 1 kΩ, 30 pF, nominal

Maximum Input: 3V rms

Display: LED with leading zero suppression, decimal, and annunciators. 9-digits (7220A), 8-digits (7260A, 7261A), 7-digits (7250A)

Cycle Rate: Fixed 250 ms between readings

Reset: Reset button clears display, lights all display segments and, on release, activates a new measurement

Self Check: Counts and displays 10 MHz clock

Temperature: 0°C to 40°C, operating; -40°C to +70°C, non-operating

EMI: Internal metal RFI shield meets most requirements of MIL-STD-461, Notice 3

Safety: Designed to meet requirements of UL 1244 and IEC 348

Power: 100V, 120V, 220V or 240V ac ±10%, 47 to 63 Hz, 32 VA max

Size: 32.7 cm L x 20.3 cm W x 10.8 cm H (12.9 in L x 8.0 in W x 4.3 in H)

Weight: 3 kg (6.5 lb), 7250A, 7260A, 7261A; 3.2 kg (7 lb), 7220A

Included: Instruction manual, power cord, serialized and dated calibration certificate

Option Specifications

Battery Pack Option (-010)

Type: Nickel-Cadmium, size F

Operating Time (Typical): 7220A, 5.5 hours; 7250A, 3.5 hours; 7260A, 2.8 hours, 7261A, 2 hours

Charge Time: 16 hours at room temperature

Charge Protection: Thermistor-actuated shut down of charging circuit if battery temperature exceeds 65°C

Discharge Protection: Automatic low-voltage shutdown to prevent over discharge

7200 Series

Timebase Characteristics

Character-istics	Option			
	Stan-dard	-112 TCXO	-131 Oven	-132 Oven
Frequency	10 MHz	10 MHz	10 MHz	10 MHz
Aging Rate (Const Temp)	$\pm 5 \times 10^{-7}$ /mo	$\pm 3 \times 10^{-7}$ /mo* $\pm 1 \times 10^{-6}$ /yr	$\pm 1 \times 10^{-7}$ /mo*	$\pm 5 \times 10^{-8}$ /mo* $\pm 3 \times 10^{-9}$ /day*
Temperature Accuracy (0°C to 40°C)	$<5 \times 10^{-6}$ **	$\pm 2 \times 10^{-6}$	$\pm 1 \times 10^{-7}$	$\pm 3 \times 10^{-8}$
Line Varia-tion (±10% change)	$\pm 1 \times 10^{-7}$	$\pm 2 \times 10^{-8}$	$\pm 2 \times 10^{-8}$	$\pm 4 \times 10^{-9}$
Battery Operation	$\pm 1 \times 10^{-7}$	$\pm 2 \times 10^{-8}$	$\pm 5 \times 10^{-8}$	$\pm 1 \times 10^{-8}$
Warm-up 10 Minutes 20 Minutes	 — —	 — —	 $\pm 5 \times 10^{-7}$ $\pm 3 \times 10^{-8}$	 $\pm 5 \times 10^{-7}$ $\pm 3 \times 10^{-8}$

**After five days of continuous operation*

***Peak-to-peak variation over temperature range*

****Compared to frequency 24 hours after turn on*

(1) *Timebase error is the sum of all errors specified for the particular timebase (see timebase specifications)*

(2) *Trigger error is the measurement error caused by noise on the input signal triggering the input amplifier too early or too late, calculated as follows:*

$$\text{Microseconds of trigger error} = \frac{2 \times \text{pk noise voltage (V)}}{\text{signal slope at trigger point (V/}\mu\text{s)}}$$

or Trigger error +±0.3% of one period divided by number of periods averaged for signals with better than 40 dB signal to noise ratio and 100 mV rms amplitude, whichever is greater.

Timebase Phase Modulation Option (-190) 7261A only

Description: Option insures valid time interval averaging of clock-synchronous signals by phase modulating internal timebase

520 MHz Channel C Option (-310) (7260A, 7261A)

Range: 50 MHz to 520 MHz
Sensitivity: 10 mV rms
Input Impedance: 50 Ohms
VSWR: 2.5:1, maximum

1300 MHz Channel C Option (-331) (7260A, 7261A)

Range: 100 MHz to 1300 MHz
Triggered Mode: Handles bursts as short as 3.6 ms
Sensitivity: 5 mV rms to 600 MHz, 10 mV rms from 600 MHz to 1000 MHz, 40 mV rms above 1000 MHz
Input Impedance: 50 Ohms
VSWR: 2.5:1, maximum
Maximum Input: 5V rms, fuse protected

Resolution Multiplier Option (-351) (7220A only)

Description: Frequency-locked loop circuit designed to increase low frequency resolution 1000 times
Range: 10 Hz to 10 kHz
Lock Time: 1.5 seconds
Resolution: 0.0001 Hz to 0.1 Hz in decade steps
Accuracy: ±2 counts ± timebase accuracy*
**See timebase characteristics for timebase accuracy*

Data Output Option (-521)

Type: Serial BCD output of all digits and measurement units
Levels: TTL, "1" state low

Personality Card Option (-522K)

For 1120A IEEE-488 Translator. Part of Option -529

IEEE-488 Interface Option (-529)

Description: Interfaces to IEEE-488 via the Fluke 1120A IEEE-488 Translator. (Note: 1120A must be purchased separately.) Provides full measurement output capability as well as remote selection of all functions and ranges.
Repertoire: SH1, AH1, T5, L4, SR1, RL2, DC1, DT1

Ordering Information

Models

January 1989 prices

7220A Communications Counter	$1525
7250A Universal Counter/Timer	1250
7260A Universal Counter/Timer	1575
7261A Universal Counter/Timer	1825

Options

All options may be ordered with all models, except as indicated.

72XXA-010* Rechargeable Batter Pack	475
7220A-111 1 ppm TCXO (7220A only)	210
72XXA-112* 2 ppm TCXO (7250A, 7260A, 7261A)	275
72XXA-131* Low Power Oven	350
72XXA-132* Superior Low Power Oven	575
72XXA-190** Timebase Phase Modulation	205
72XXA-310* 520 MHz Channel C (7260A, 7261A)	425
72XXA-331*** 1300 MHz Channel C (7260A, 7261A)	750
7220A-351* 1000X Resolution Multiplier (7220A only)	105
72XXA-521* PTI Interface w/PTI Cable	225
72XXA-522K Personality Card for 1120A	$250
72XXA-529 IEEE-488 Interface	425

**Factory or Service Center installation only.*

***Factory installation only.*

****Not compatible with Option -010. Also factory option only.*

[1] *The -529 Option can be ordered and installed at time of manufacture only. Includes parts needed to interface the 7260A or 7261A to IEEE-488 via the Fluke 1120A IEEE-488 Translator. Includes -521, -522K, and Y7203 2 ft ribbon cable. For existing instruments which do not have the -529 Option installed, an IEEE interface can be added by ordering -521 and -522K Options (1120A also required).*

Accessories (Also see page 485)

1120A IEEE-488 Translator	590
A53 Whip Antenna	30
Y7201 Attenuator/Filter	65
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω, BNC to BNC	20
Y9112 6 ft (1.85m) Coaxial Cable, 50Ω, BNC to BNC	20
Y9103 50ΩBNC Feed-thru Termination	35
Y2014 5" Rack Adapter, Single	95
Y2015 5" Rack Adapter, Double	95
Y2020 Panel Mounting Kit	95
Y7203 2 ft PTI Ribbon Cable	55
Y7204 5 ft PTI Ribbon Cable	70
Y2023 PTI Accessory Case	130

Service & Support

Warranty

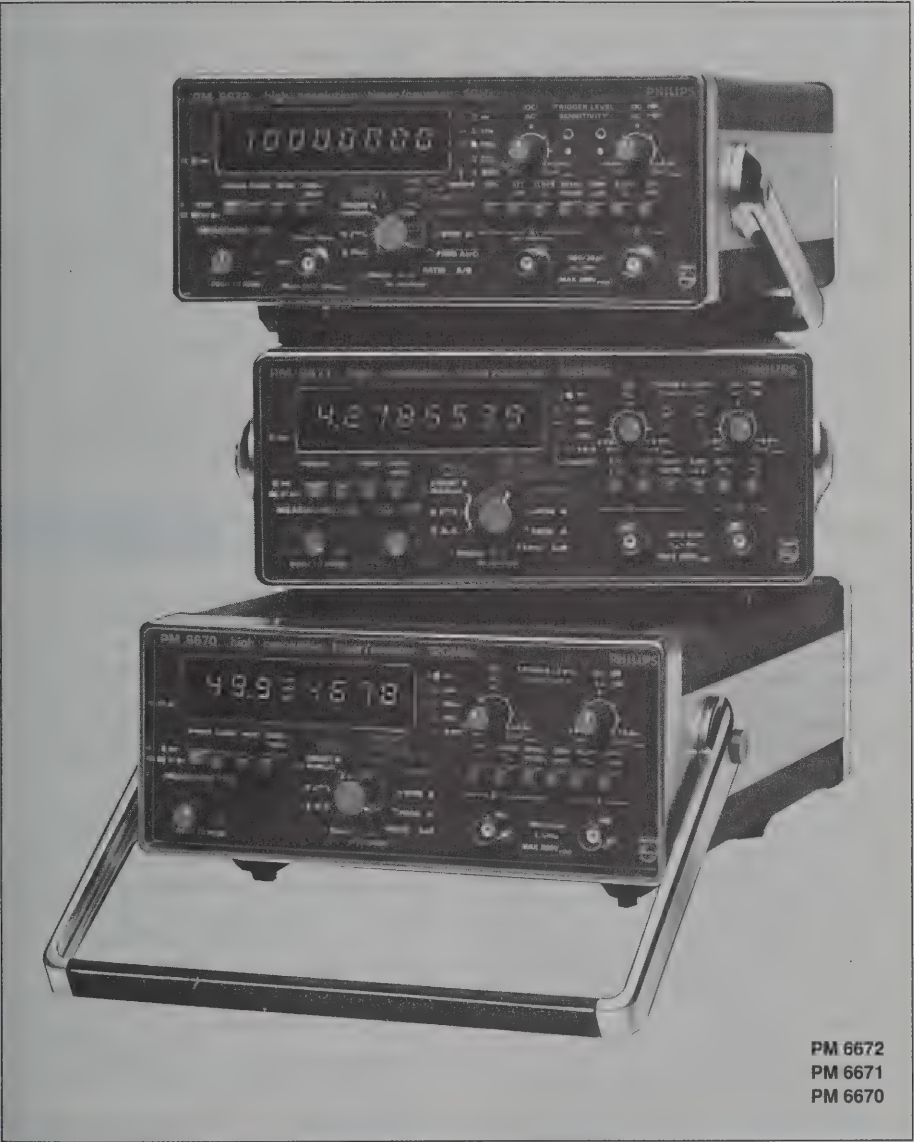
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-7220A Repair (w/calibration)	90
SC1-7220A Repair (cal w/in or out data)	105
SC1-7220A Repair (cal w/in and out data)	120
SC2-7220A Cal (1 per yr recommended)	45
SC2-7220A Cal (1 per yr w/in or out data)	60
SC2-7220A Cal (1 per yr w/in & out data)	75
SC1-7250A Repair (w/calibration)	95
SC1-7250A Repair (cal w/in or out data)	110
SC1-7250A Repair (cal w/in and out data)	125
SC2-7250A Cal (1 per yr recommended)	45
SC2-7250A Cal (1 per yr w/in or out data)	60
SC2-7250A Cal (1 per yr w/in & out data)	75
SC1-7260A Cal Repair (w/calibration)	114
SC1-7260A Repair (cal w/in or out data)	149
SC1-7260A Repair (cal w/in and out data)	184
SC2-7260A Cal (1 per yr recommended)	63
SC2-7260A Cal (1 per yr w/in or out data)	98
SC2-7260A Cal (1 per yr w/in & out data)	133
SC1-7261A Cal Repair (w/calibration)	138
SC1-7261A Repair (cal w/in or out data)	173
SC1-7261A Repair (cal w/in and out data)	208
SC2-7261A Cal (1 per yr recommended)	63
SC2-7261A Cal (1 per yr w/in or out data)	98
SC2-7261A Cal (1 per yr w/in & out data)	133

PM 6670, PM 6671 & PM 6672

GPIB IEEE-488



PM 6672
PM 6671
PM 6670

PM 6670, PM 6671 & PM 6672 Reciprocal Timer/Counters
High resolution frequency measurements
GPIB/IEEE-488 option
High stability Crystal oscillators, up to 5 x 10^{-10}/24h
Time interval average with down to 10 ps resolution
High trigger accuracy
Excellent 10 mV sensitivity
Burst frequency average, Phase and RPM

These microcomputer-based timer/counters satisfy virtually all frequency and time measurement requirements. Their general purpose versatility, wide frequency range, high accuracy crystal oscillators and new powerful measuring features make them ideal for research and development applications.

Lightweight, compact construction results from the dramatically reduced number of components — down to only a few state-of-the-art LSI circuits, including a custom-designed counter-on-a-chip and a one-chip microcomputer. Philips advanced R & D capability allows size and cost reduction while still providing the ultimate in reliability and performance.

A choice of interfaces, including the GPIB/IEEE-488* bus puts this capability at the user's disposal for production and quality assurance testing. In addition, the optional battery unit extends the use of the instruments to field service applications.

Choice of Time Base Oscillator

The time base crystal oscillator determines the accuracy limit of the counters.

Note that even the most stable version (5 x 10^{-10}/24h) can be operated from internal batteries. This unique feature is achieved by specially developed oven-stabilized crystal oscillators with extremely low power consumption. Thus laboratory accuracy is now available for field applications — without irritatingly long warm-up times after changing location.

By means of the external reference input, the user's own frequency standard can be used when available.

High Resolution Computing Frequency Counting

By making a synchronized multiple-period measurement and computing the reciprocal value these timer/counters perform high resolution frequency measurements on all low frequency signals. The built-in microcomputer eliminates traditional ±1 input cycle errors and as a result gives at least seven digits resolution per second of measuring time. This avoids the need for long gate times, period measurements or phase-locked frequency multipliers, normally required to obtain a high resolution.

High Time Resolution

For time interval measurements these instruments also feature a very high measuring resolution. By using the time interval averaging technique, these timer/counters greatly improve both the measuring accuracy and resolution.

Compared to single time interval measurements, the basic 100 ns resolution is improved by a factor of $\sqrt{N}$, where N is the number of time intervals being averaged.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

With the PM 6670/71/72, N can be more than 10^8. The resolution then becomes:

$$\frac{100\text{ ns}}{\sqrt{10^8}} = 10\text{ ps}$$

High Trigger Accuracy...

Ultimately, no counter is better than its front-end circuitry. Therefore the PM 6670 series employs the best front-end circuit concept available.

These timer/counters feature special input signal conditioning configurations, which are optimized for both frequency and time interval measurements, e.g. either adjustable trigger levels for time interval measurements or adjustable sensitivity and noise immunity for frequency measurements.

...for Time Measurements

Meaningful use of the averaging technique is made through the high-speed synchronizers and equalized input channels. Amplifiers and Schmitt-trigger circuits for both start and stop channel are all on the one IC-chip, thereby avoiding differences in delay and rise times. This reduces systematic trigger errors which cannot be eliminated by averaging.

Systematic trigger errors are further reduced by the low hysteresis via the use of high sensitivity input amplifiers, as shown in the counter's introduction section.

The PM 6671 and 6672 feature trigger level outputs on the front panel, allowing accurate measurements to be made of the set trigger level with a DVM. The trigger level can also be positioned accurately with respect to the waveform using an oscilloscope.

...for Frequency Measurements

For frequency measurements, the trigger control can be selected to act as a wide-band, continuously variable input attenuator (x1...x100) to allow optimum matching of trigger sensitivity and noise immunity.

Noise Rejection Filter

To obtain full benefit from the high resolution reciprocal design, noise and interference can be excluded by a switchable built-in noise-rejection filter for low frequency measurements. This filter even rejects HF noise or interference that is stronger than the input signal itself.

Automatic Triggering on RF Signals

The 1 GHz model PM 6672 has a special RF input with front-end circuits that feature advanced RF techniques, including automatic PIN-diode attenuators that bring a number of user benefits:

- Automatic triggering
- Excellent overload protection; 12 Vrms
- High AM tolerance: up to 98%
- Wide dynamic range: 15 mVrms...12 Vrms

RFI Suppression

Effective precautions have been taken to reduce radiation and susceptibility to radio frequency interference (RFI) to minimum levels. For example, all the counters are encased in sturdy metal cabinets, which provide excellent RFI shielding. Reduction of RFI radiation far below the most severe requirements, including VDE 0871 (B) and MIL STD 461, contributes to the superior accuracy of these models.

Variable Measuring Time

A valuable microcomputer benefit is the continuously variable measuring time, which is no longer limited to decade steps. It is possible, for example, to select a measuring time of 2.4 seconds if one second does not give sufficient resolution. This avoids the need to switch directly to a time-wasting 10 second measurement period.

Phase and RPM

Another microcomputer benefit in these timer/counters is the possibility of new measuring functions — such as phase and RPM (revolutions/minute) — which are not normally found in counters.

A simultaneous measurement of period duration and the phase delay between two signals allow the microcomputer to calculate and display phase delays directly in degrees.

Trigger Hold-Off and Arming

The PM 6671/6672 give full control over the start conditions of a measurement. With an external gate signal, one can prevent the timer/counter from triggering on the first input signal.

Another useful feature, found on the PM 6671 is trigger hold-off, which avoids false stop triggering on spurious or unwanted signals. A typical example is the pulses from relay contact bounce (see fig. 1).

Trigger Indicators

Tri-state trigger indicator LEDs on the PM 6671 and PM 6672 facilitate quick setting of the trigger level. LEDs for channel A and B blink to indicate that these inputs are triggered. Lights on/off indicate that the trigger level is too low/high. This feature is of great help, particularly when making time interval measurements, where both channels have to be triggered correctly.

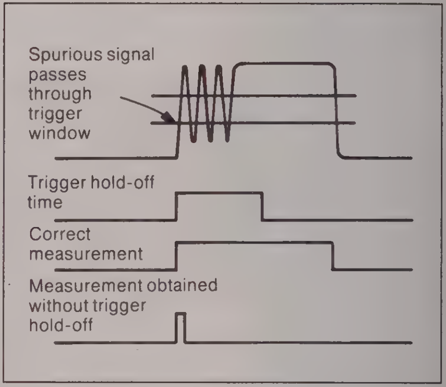

Spurious signal passes through trigger window
Trigger hold-off time
Correct measurement
Measurement obtained without trigger hold-off

Fig. 1. The use of the PM 6671 variable trigger hold-off enables the influence of spurious signals such as ringing or relay bounce to be ignored and correct measurements obtained.

Specifications

Measuring Modes

Frequency

Range: 0.1 Hz...120 MHz (all models); 0.1 Hz...1 GHz (PM 6672)
Mode: Input signal synchronized, high resolution computing measuring method (reciprocal).
Signal Mode: CW, SINGLE BURST, MULTIPLE BURST FREQUENCY AVERAGE
LSD Displayed: 10^{-7} Hz...10^{3} Hz (PM 6670, 6671). 10^{-7} Hz...10^{4} Hz (PM 6672), depending on measuring time and input frequency. At least 7 digits displayed per second of measuring time.
Resolution: LSD*
Inaccuracy (rel. error):

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \frac{\text{trigger* error}}{\text{measuring time}}$$

± rel. time base error

Period Average

Range: 100 ns...100s
***LSD Displayed:** 10^{-15}...10^{-6}s, depending on measuring time and period duration. At least 7 digits displayed per second of measuring time.
Resolution: LSD*
Inaccuracy (rel. error):

$$\pm\frac{\text{resolution}}{\text{PERIOD}} \pm \frac{\text{trigger* error}}{\text{measuring time}}$$

± rel. time base error

**See definitions*

PM 6670, PM 6671 & PM 6672

Time Interval A to B; Single

Range: 100 ns...10^8s
LSD Displayed: 10^{-7}s...10^0s
Resolution: LSD*
Inaccuracy (rel. error):

$$\pm \frac{\text{resolution} \pm \text{trigger* error}}{\text{TIME INT}}$$

± rel. time base error

Pulse Width A

Pulse width measurements are similar to single time interval measurements. Both start and stop triggering take place in channel A, with common trigger level setting and automatic trailing edge trigger slope inversion with respect to selected leading edge trigger slope.
All other specifications are identical to single time interval. High resolution, pulse width measurements on narrow pulses can be made in the time interval average mode with manual selection of common source and stop slope polarity.

Time Interval A to B; Average

Range: 0 ns...100s
LSD Displayed: 10^{-15}s...10^{-6}s, depending on measuring time and time interval.
Resolution:

$$\frac{10^{-7}\text{s}}{\sqrt{N}} \text{ or 1 LSD unit, whichever is greater}$$

Inaccuracy (rel. error):

$$\pm \frac{4\text{ ns} \pm \text{resolution}}{\text{TIME INT}} \pm \frac{\text{trigger* error}}{\sqrt{N} \times \text{TIME INT}}$$

± rel. time base error.

Number of Intervals Averaged (N): Measuring time x interval repetition rate.
Minimum Dead Time from Stop to Start: 300 ns

Note: Input signal must be repetitive and asynchronous with respect to the time base.

Count A

Totalize Range: 1...10^{17}, with indication of M-pulses and G-pulses beyond the 10^8 display range.
Pulse Pair Resolution: 80 ns
Mode:
Manual: Start-stop by DISPL. HOLD push button. Sequential start-stop periods are accumulated or individually totalized after reset.
External: Totalizing interval controlled via input B, selectable: count A gated during pulse duration on B or count A gated between start and stop pulse on B.
Inaccuracy: Pulse repetition rate A x trigger* error B.

Phase A-B

Phase is the result of a simultaneous time interval average and period average measurement. The maximum phase range is therefore limited, due to the 300 ns dead time between stop and start of the next time interval, and consequently frequency dependent. For phase measurements between 180° and 360° on high frequency signals, measure the complementary phase 0°...180° by changing the input leads (phase B to A).
Phase Range:
0.1°...360° x [1-(300 ns x FREQ)]
Example: 0.1°...359.995° at 50 Hz
0.1°...357.3° at 25 kHz
0.1°...180° at 1.666 MHz

Frequency Range: 0.03 Hz...1.6 MHz
LSD Displayed: 10^{-6}...10^{-2} degrees, depending on measuring time and phase difference.
Resolution:

$$\frac{10^{-7}\text{s} \times \text{FREQ} \times 360°}{\sqrt{N}}$$

Inaccuracy (rel. error):

$$\pm \frac{4\text{ ns} \times 360° \times \text{FREQ}}{\text{PHASE}} \pm \frac{\text{resolution}}{\text{PHASE}}$$

$$\pm \frac{\text{trigger* error} \times \text{FREQ} \times 360°}{\sqrt{N} \times \text{PHASE}}$$

Number of Input Cycles Averaged (N): Measuring time x FREQ A.
Minimum Input Signal: 100 mVrms
Phase Jitter Tolerance: The tolerated phase jitter peak-value ≤ phase difference, i.e. phase jitter around 0° should not cause consecutive measurement results of slightly above 0° and slightly below 360° since the total measurement results is the statistical average of all individual results.

Ratio

Range: $\frac{\text{FREQ A}}{\text{FREQ B}} = \frac{0...10\text{ MHz}}{0...10\text{ MHz}}$ (all models)

LSD Displayed: 10^{-7}...10^0
Resolution: LSD*
Inaccuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{RATIO}} \pm \text{rel. trigger* error B}$$

Note: Frequency ratio measurements

$$\frac{\text{FREQ A (or C)**}}{\text{FREQ D}} = \frac{0.1\text{ Hz...120 MHz(or 1 GHz)**}}{50\text{ kHz...10 MHz}}$$

can also be made in the frequency mode, by making use of the external reference input D. However, this arrangement does not give correct decimal points.

RPM

The RPM (revolutions per minute) mode is similar to the frequency mode. The measured frequency is multiplied x 60 before being displayed.
Range: 0.6 RPM...10^8 RPM (with one pulse per revolution).
LSD Displayed: 10^{-7} RPM...10^0 RPM, depending on measuring time and RPM.
Resolution: LSD*
Accuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{RPM}} \pm \frac{\text{trigger* error}}{\text{measuring time}}$$

± rel. time base error

Auxiliary Functions

Measuring Time

The measuring time is "continuously" variable (33 steps/decade): 10 ms...96s, with clear set-points at 10 ms, 100 ms, 1s, 10s and 96s. Selected measuring time is displayed, without any delay, when depressing the measuring time control.

Hold-Off

With trigger hold-off activated, the counter ignores retriggering (channel A) or stop triggering (channel B) during the set hold-off time. The hold-off time can be digitally measured by pressing CHECK.
Applicable in all time modes.
Range: 200µs...200 ms, in period, time interval and pulse width mode, the set hold-off time is visible with CHECK depressed.
On/Off Indication: LED indicates when hold-off is activated.
Monitor: The selected hold-off duration can be made visible via the gate monitor output.

On/Stand By

In "ST BY" position, power is available to maintain an ovenized crystal oscillator heated and to recharge the optional battery pack.

Check

10 MHz internal reference connected to logic circuitry. Self-test of most measuring functions can be selected. By using this mode, the COUNT function provides a stop-watch facility.

Display Hold

Depressing "DISP HOLD" button sets display time to infinite and freezes the last measurement result. A new measurement can be initiated using reset.
In the COUNT mode, the "DISP HOLD" control is used to start and stop manual totalizing.

Reset

Manual via push button or electrical via input E.

Input and Output Specifications

Inputs A and B

Frequency Range: *DC coupled:* 0...120 MHz; *AC coupled:* 50 Hz...120 MHz
Rise Time: Approx. 4 ns
Sensitivity:
*DC coupled:*10 mVrms sinewave or 30 $\text{mV}_{\text{p-p}}$ (0...75 MHz), 20 mV rms sinewave or 60 $\text{mV}_{\text{p-p}}$ (75...120 MHz)
AC coupled: 10 mVrms...100 mVrms sinewave (0...75 MHz), 20 mVrms...100 mVrms sinewave (75...120 MHz)

**See definitions*
***C only on PM 6672*

Attenuation: x 1/x 10 fixed.
For frequency related measurements, the fixed attenuator can be used in combination with the continuously variable attenuator x 1...x 10 (AC coupled position).
Noise Immunity/Hysteresis Band:
DC coupled: approx. 20 mV$_{p-p}$/200 mV$_{p-p}$
AC coupled: approx. 20 mV$_{p-p}$...2V$_{p-p}$
Dynamic Input Voltage Range:
DC coupled: 30 mV$_{p-p}$...5V$_{p-p}$/
300 mV$_{p-p}$...50V$_{p-p}$
AC coupled: 10 mVrms...2 Vrms/100 mVrms... 20 Vrms
Trigger Level:
DC coupled: -2.5V...+2.5V/-25V...+25V
AC coupled: fixed 0V; level control acts as continuously variable attenuator, which is more suitable for frequency related measurements.
Trigger Level Output: Set trigger voltage -2.5V ...+2.5V, available on 1 mm jacks at the front for monitoring of set trigger level. (Not available on PM 6670).
Trigger Indicators: Tri-state LED trigger lights to indicate trigger status:
Coupling: DC/AC
Impedance: Approx. 1 MΩ//35 pF, independent of sep/com switch position.
Channel Input: Separate A and B or common A
Noise Filter: Switchable 50 kHz Low pass filter in channel A. Noise suppression approx. 40 dB at 1 MHz.
Maximum Voltage Without Damage:
DC: 300V
AC: 260 Vrms at ≤440 Hz declining to 12 Vrms at ≥1 MHz (in ATT x 1 position), 260 Vrms (in ATT x 10 position).

Input C (PM 6672 only)

Frequency Range: 70 MHz...1 GHz
Operating Input Voltage Range: 15 mVrms... 12 Vrms (70 MHz...800 MHz).
25 mVrms...12 Vrms (800 MHz...1 GHz).
Impedance: 50Ω nominal; VSWR <2
Coupling: AC
AM Tolerance: 98%; minimum signal must exceed minimum operating input voltage.
Maximum Voltage Without Damage: 12 Vrms; overload protection with PIN diodes.

Ext. Reference and Ratio Input (Ch. D)*

Frequency Range: 50 kHz...10 MHz
Sensitivity: 500 mVrms
Impedance: Approx. 2 kΩ
Coupling: AC
Max. Voltage Without Damage: 25 Vrms

Note: as external reference frequency, only 10 MHz will give correct decimal point and unit indication. With the optional frequency multiplier PM 9697 references of 1 and 5 MHz can also be accepted.

Internal Standard Output (Ch. D)*

Crystal Frequency: 10 MHz
Output Level: LS-TTL compatible
Output Impedance: Approx. 400Ω
Coupling: DC
Overload Protection: Short circuit proof

Ext. Arming/FREQ-Avg/Reset (Ch. E)*

A 3-position rear panel switch gives choice of external control over:
Arming: In this position, the counter is prevented from starting a new measurement when input E is high. A high-to-low going pulse arms the counter to start a new measurement.
Note: Arming not applicable in COUNT A, manual mode.

Frequency Average: Frequency measurements (max. 100 MHz) and period measurements are interrupted when input E is high. The measurement is continued again when input E is low. Each individual frequency sample must contain at least 20 pulses (FREQ mode) or 2 pulses (PERIOD mode).
The effective measurement time (defining resolution and accuracy) is the sum of external gate times that occurs during the selected measurement time.
Ext. Reset-Start: Electrical reset, equivalent to the front panel RESET push button. (See HOLD and RESET). Counter is reset when input E goes high. A new measurement can be made after input E has returned low.
Input Levels: High: ≥2V; Low: ≤0.5V
Input Impedance: Approx. 2 kΩ
Max. Input Voltage Without Damage: ±25V
Minimum Pulse Duration: Arming and frequency avg.: 500 ns; External reset: 200 µs

Gate Monitor Output (Rear)

The gate status monitor output permits observation on an oscilloscope of the measured time interval and the trigger hold-off time (PM 6671 only).
Output Level: Main gate open: approx. 0.4V; Hold-off active: approx. 1.2V;
Main gate closed: approx. 2.5V
Output Impedance: Approx. 1.5 kΩ
Delay: Internal dealy between actual triggering and gate monitor output is approx. 150 ns.
Overload Protection: Short circuit proof

General Specifications

Time Base

For specifications, see table on following page.

Display

Readout: 8 digits, 7.6 mm high-efficiency LEDs. Microprocessor control of display format, decimal point and unit indication: Hz, kHz, MHz, GHz, ns µs, ms and s.
Display Time: Continuously variable 80 ms... 96s plus DISP HOLD.
Gate Lamp: Indicates that main-gate is opened and measurement takes place.
ST BY: Stand-by indication with LED when instrument is not switched ON.
REMOTE*: Indicates when control over counter is taken by the installed BUS interface option (IEC 625-IEEE 488).
Low-Battery*: Indication by blinking display some 15 min. before recharging is needed.

Power Requirements

In addition to the normal line voltage supply, the PM 6671 and PM 6672 can also be powered from an optional battery pack or external DC voltage.
Line: 115/230V ±15%; 45...440 Hz; <25 VA
Internal Battery Unit*: PM 9693
External DC Source: 11.8V...28V
Line Interference: Below VDE 0871 (B) and MIL STD 461
Safety: According to IEC 348 and CSA 556 B

Dimensions and Weight

Dimensions: 210 mm W x 89 mm H x 280 mm L (8.25 in W x 3.8 in H x 11 in L)
Weight: 2.5 kg (5.5 lb)

Environmental Conditions

Temperature
Rated Range of Use: -5°C...+50°C
Storage and Transport: -40°C...+70°C
Humidity
Operating: 10...90% RH, no condensation.
Storage: 5...95% RH.
Altitude/Barometric Pressure
Operating: 5000m (15000 ft) -53.3 kN/m²
Storage: 15000m (50000 ft) -15.2 kN/m²

Definitions

LSD Displayed

Unit value of least significant digit, displayed.

For FREQUENCY, PERIOD AVERAGE, RPM and PHASE

$$\text{LSD} = \frac{2.5}{\text{measuring time}} \times \frac{\text{FREQ or PERIOD or RPM or } 360^\circ}{10^{-7}\ \text{Hz}}$$

For RATIO

$$\text{LSD} = \frac{2.5 \times \text{prescaling factor (P)} \times \text{RATIO}}{\text{measuring time} \times \text{FREQ A or C}}$$

(P) + 1 Channel A, all models
(P) + 256 Channel C, PM 6672

For SINGLE TIME INTERVAL and PULSE WIDTH

LSD = 100 ns (for times <10s).

$$\text{LSD} = \frac{5 \times \text{TIME}}{10^{8}} \text{ (for times >10s)}$$

**Not available on PM 6670*

For TIME INTERVAL AVG

$$\text{LSD} = \frac{2.5 \times 10^{-7}\text{s}}{\text{meas. time x time int. rep. rate in Hz}}$$

All calculated LSDs shall be rounded to nearest decade (e.g. 5 ns will be 10 ns and 0.4 Hz will be 0.1 Hz) and cannot exceed the 8th digit.

Resolution

For Multiple Event Measurements: FREQUENCY, PERIOD AVERAGE, RPM AND RATIO, the resolution is the smallest increment between two measuring results, being most often 1 LSD unit. Due to arithmetic truncation, the resolution can be 2 LSD units if:

$$\frac{\text{LSD x measuring time}}{\text{FREQ or PERIOD or RPM or RATIO}} < 10^{-7}\text{s}$$

but can then be reduced to 1 LSD unit, by doubling the measuring time.

For Single Event Measurements: PULSE WIDTH and SINGLE TIME INTERVAL, the measuring resolution is 100 ns (one clock pulse). The counter can accumulate up to 10^{15} clock pulses, of which only the 8 most significant digits are shown.

For Statistical Measurements: TIME INTERVAL AVERAGE and PHASE, the measuring resolution is the smallest increment between two measuring results, with confidence level of 95%.

Trigger Error

Trigger error is the absolute measurement error due to noise on the input signal causing a too early or too late triggering.

For any Waveform (FREQ, PERIOD, RATIO, RPM and PULSE WIDTH):

$$\frac{\text{peak-to-peak noise voltage}}{\text{signal slope (V/s) x measuring time}}$$

For Sinewave (FREQ, PERIOD, RATIO, RPM):

$$\frac{1}{\text{FREQ x } \pi \text{ x S/N ratio}}$$

Example: For S/N ratio of 100 (40 dB) and 1 second measuring time, the trigger error is:

$$\frac{3 \times 10^{-3}}{\text{FREQ}}$$

For Separate Source TIME INTERVAL:

$$\pm \frac{\text{peak noise voltage (input A)}}{\text{signal slope A (V/s)}}$$

$$\pm \frac{\text{peak noise voltage (input B)}}{\text{signal slope B (V/s)}}$$

For PHASE:

$$\frac{1}{\text{FREQ x } 2\pi} \text{ x } \left(\frac{1}{\text{S/N ratio (input A)}} \pm \frac{1}{\text{S/N ratio (input B)}}\right)$$

Note: S/N ratios calculated with peak-to-peak signal and noise values.

Interface Data

IEEE interface option PM 9696: Can be supplied fitted (to order), or retrofitted in the field.
Connector: 24-pole: address set by switches
Output Data: Measuring data including function code, overflow and range. Status data, generated at serial poll or after instruction, including full programming status data and function status
Output Rate: 10...20 readings per second
Input Data: Programing data for all manually controllable functions except input trigger functions

Included with Instrument: Operator's manual, line cord

Ordering Information

Models

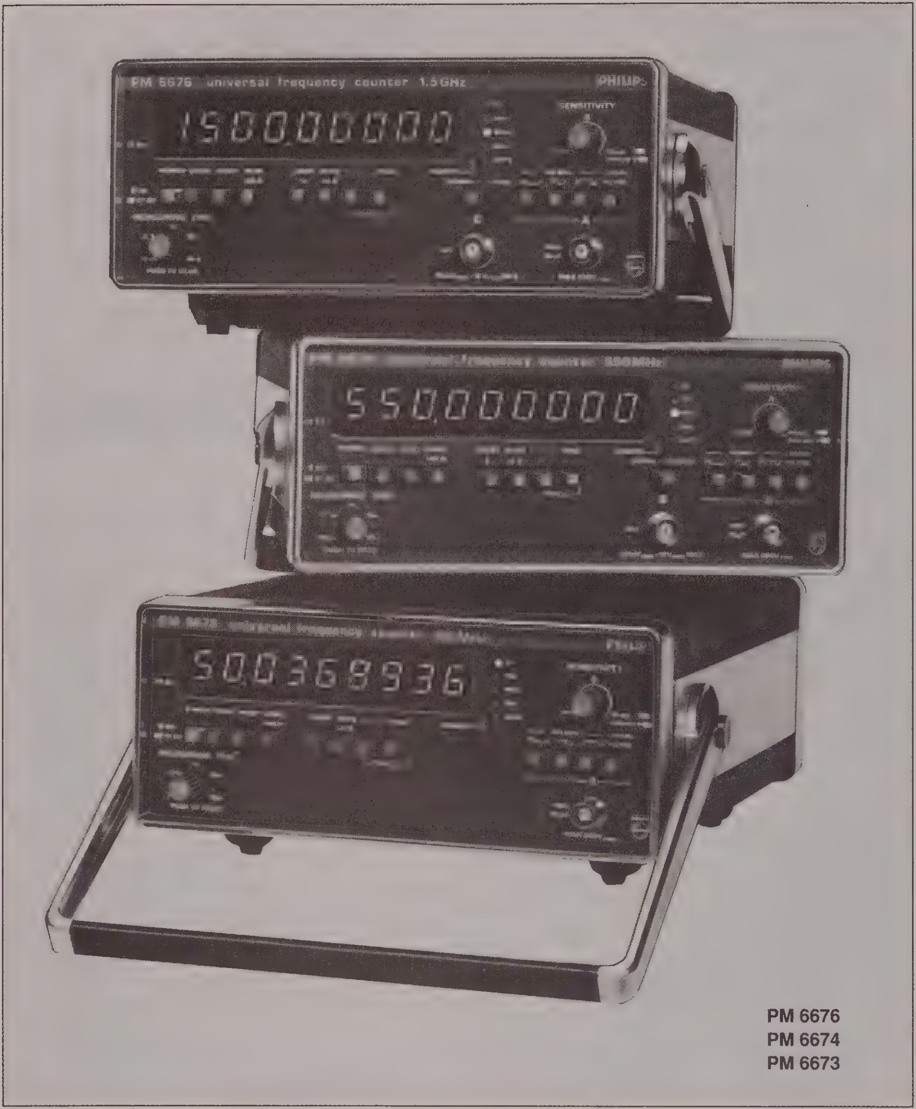
For ordering information, see counter models PM 6673 - PM 6676, page 351

Crystal Oscillator Summary

PM 66../...Version Including Time Base Option	**/.1. Standard Version**	**/.2. Version PM 9678**	**/.3. Version PM 9679**	**/.4. Version PM 9690**	**/.5.Version PM 9691**
Stability Against	Standard	TCXO	Oven	Oven	Oven
Aging:/24h /Month /Year	N/A <5 x 10^{-7} <5 x 1^{-6}	N/A <1 x10^{-7} <5 x 10^{-7}	N/A <1 x 10^{-7} <5 x 10^{-7}	<1.5 x 10^{-9*} <3 x 10^{-8} <1.5 x 10-7	<5 x 10 $^{-10*}$ <1 x 10^{-8} <7.5 x 10^{-8}
Temperature: 0°C to 50°C Ref. to +23°C	<1 x 10^{-5}	<1 x 10^{-6}	<1 x 10^{-7}	<3 x 10^{-8}	<5 x 10^{-9}
Change in supply Mode: line/int. battery /ext. DC 12V to 28V	<3 x 10^{-7}	<5 x 10^{-8}	<1 x 10^{-8}	<3 x 10^{-9}	<3 x 10^{-9}
Line Voltage:±10%	<1 x 10^{-8}	<1 x 10^{-9}	<1 x 10^{-9}	<5 x 10^{-10}	<5 x 10^{-10}
Warm-up time to reach 10^{-7} of final value	N/A	N/A	<10 min	<15 min	<15 min

**After 48 hours of continuous operation.*

PM 6673, PM 6674, PM 6675 & PM 6676



PM 6676
PM 6674
PM 6673

PM 6673-PM 6676 High Resolution Universal Frequency Counters

- High resolution frequency measurements
- Error-free triggering
- High stability crystal oscillators up to 5×10^{-10}/24h
- Programmable via GPIB/IEEE-488 option
- High 10 mV sensitivity
- Multiple burst frequency average
- BCD or analog output

These microcomputer-based universal frequency counters satisfy virtually all frequency measurement requirements. Their high accuracy concept, wide frequency ranges and new powerful measuring features make these counters ideal for research and development of telecommunication, broadcast, TV, radio control and navigation equipment.

Lightweight, compact construction results from the dramatically reduced number of components — down to only a few state-of-the-art LSI circuits, including a counter-on-a-chip and a one-chip microcomputer. Philips' advanced R & D capability yields reduction in size and cost while still providing the ultimate in reliability and performance.

A choice of interfaces, including the GPIB/IEEE- 488* bus puts this capability at the user's disposal for production and quality assurance testing. In addition, the optional battery unit extends the use of the instruments to field service applications.

High Resolution Computing Counting

By making a synchronized multiple-period measurement and computing the reciprocal value, the counters perform high resolution frequency measurements on all low frequency signals. The built-in microcomputer eliminates traditional ±1 input cycle errors and as a result gives at least seven digits resolution per second of measuring time. This avoids the need for long gate times, period measurements or phase-locked frequency multipliers, normally required to obtain a high resolution. Above 10 MHz, the conventional counting method is automatically selected, to give improved resolution at the higher frequencies (see fig. 1).

Error-Free Triggering

Ultimately, no counter is better than its front-end circuitry. Therefore the PM 6670 series employs the best front-end circuit concept available. The wideband, continuously variable input attenuator allows optimum matching of trigger sensitivity and noise immunity over a wide dynamic range from $20\ \text{mV}_{pp}$ to 10V_{pp}. See introduction of the counter section.

To obtain full benefit from the high resolution reciprocal design, meaningless digits can be excluded by a switchable built-in noise-rejection filter for low frequency measurements. This filter even rejects HF noise or interference that is stronger than the input signal itself.

Automatic Triggering on RF Signals

The UHF counter models PM 6674, 6675 and 6676 have special RF inputs up to 550 MHz, 600 MHz and 1.5 GHZ respectively. Their front-end circuits feature advanced RF techniques, including automatic PIN-diode attenuators that bring a number of user benefits:

- Automatic triggering
- Excellent overload protection; 12 Vrms
- High AM tolerance: up to 98%
- Wide dynamic range: 10 mV rms...12 Vrms

For high-speed/high-accuracy measurements, the "extra powerful" 600 MHz model PM 6675 offers direct gating (non-prescaled) and a high 5 mVrms sensitivity.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 6673, PM 6674, PM 6675 & PM 6676

RFI Suppression

Effective precautions have been taken to reduce radiation and susceptibility to radio frequency interference (RFI) to minimum levels. For example, all the counters are encased in sturdy metal cabinets, which provide excellent RFI shielding. Reduction of RFI radiation far below the most severe requirements, including VDE 0871 (B) and MIL STD 461, contributes to the superior accuracy of these models.

Variable Measuring Time

Another microcomputer benefit is the continuously variable measuring time, which is no longer limited to decade steps. It is possible, for example, to select a measuring time of 2.4 seconds if one second does not give sufficient resolution. This avoids the need to switch directly to a time-wasting 10 second measurement period.

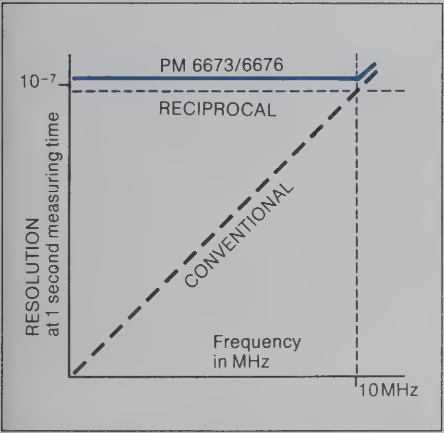


Fig. 1. The PM 6670 series benefits from both RECIPROCAL and CONVENTIONAL measuring principles. Automatic selection of the measuring mode always gives the best possibel resolution.

Choice of Time Base Oscillator

The time base crystal oscillator determines the accuracy limit of the counters.

Note that even the most stable version (5×10^{-10}/24h) can be operated from internal batteries. This unique feature is achieved by specially developed oven-stabilized crystal oscillators with extremely low power consumption. Thus laboratory accuracy is now available for field applications—without irritatingly long warm-up times after changing location.

By means of the external reference input, the user's own frequency standard can be used, when available.

Frequency Average

The use of microcomputers provides new opportunities in frequency measurements. The computing measuring principle, with sychronized sample-taking, enables frequency and period measurements to be made during one or a great number of measuring intervals. Start and duration of these intervals are controllable via an external gate input.

Individual samples may be as short as 500 ns or as long as 96 seconds.

Multiple-burst-frequency measurements or sampling frequency-sweep-profiles can be activated by a single control.

Specifications

Measuring Modes

Frequency

Range

Sine: 10 Hz...120 MHz (PM 6673)
10 Hz...550 MHz (PM 6674)
10 Hz...600 MHz (PM 6675)
10 Hz... 1.5 GHz (PM 6676)
Pulse: Minimum frequency down to 0.1 Hz

Mode: RECIPROCAL and CONVENTIONAL. For the highest possible resolution for both LF and HF measurements, the counter employs the RECIPROCAL mode for LF signals. Above 10 MHz it automatically uses the CONVENTIONAL mode.

For special applications, one can select either RECIPROCAL or CONVENTIONAL.

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST FREQUENCY AVERAGE. In the FREQUENCY AVERAGE mode (rear panel selectable), the counter measures the average of a multiple of frequency samples. Samples are taken with external gate control (≥500 ns) and totalized during the selected measuring time (10 ms...96s) to allow multiple burst frequency measurements or to sample frequency sweep profiles.

LSD Displayed: 10^{-8} Hz...10^{2} Hz (PM 6673 and PM 6675), 10^{-8} Hz...10^{3} Hz (PM 6674 and PM 6676), depending on measuring time and input frequency. At least 7 digits displayed per second of measuring time.

Resolution: LSD*

Inaccuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{FREQ}} \pm \text{rel. trigger* error}$$

± time base error

Period Average

Range: 100 ns...100s

LSD Displayed: 10^{-16}...10^{-6}s, depending on measuring time and period duration. At least 7 digits displayed per second of measuring time.

Resolution: LSD*

Inaccuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{PERIOD}} \pm \text{rel. trigger* error}$$

± time base error

Ratio

Range:

$$\frac{\text{FREQ A}}{\text{FREQ D}} = \frac{\text{10 Hz...120 MHz}}{\text{1 kHz...10 MHz}} \text{ (PM 6673)}$$

$$\frac{\text{FREQ A or B}}{\text{FREQ D}} = \frac{\text{10 Hz...550 MHz}}{\text{1 kHz...10 MHz}} \text{ (PM 6674)}$$

$$\frac{\text{FREQ A or B}}{\text{FREQ D}} = \frac{\text{10 Hz...600 MHz}}{\text{1 kHz...10 MHz}} \text{ (PM 6675)}$$

$$\frac{\text{FREQ A or B}}{\text{FREQ D}} = \frac{\text{10 Hz...1.5 GHz}}{\text{1 kHz...10 MHz}} \text{ (PM 6676)}$$

LSD Displayed:
10^{-8}...10^{-1} (A/D all models and B/D; PM 6675)
10^{-8}...10^{0} (B/D; PM 6674)
10^{-8}...10^{0} (B/D; PM 6676); depending on measuring time and ratio

Resolution: LSD*

Inaccuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{RATIO}} \pm \text{rel. trigger* error D}$$

Count

Totalize Range: 1...10^{17}, with indication of k-pulses, M-pulses and G-pulses beyond the 10^{9} display range

Frequency Range:
Sine: 10 Hz...10 MHz
Pulses: 0 Hz...10 MHz

Sequential start-stop periods are accumulated or individually totalized after reset.

Auxiliary Functions

Measuring Time

The measuring time is "continuously" variable (33 steps/decade): 10 ms...96s, with clear set-points at 10 ms, 100 ms, 1s, 10s and 96s. Selected measuring time is displayed, without any delay, when depressing the measuring time control.

On/Stand By

In "ST BY" position, power is available to maintain an ovenized crystal oscillator heated and to recharge the optional battery pack.

Check

10 MHz internal reference connected to logic circuitry. Self-test of most measuring functions can be selected. By using this mode, the COUNT function provides a stop-watch facility.

Display Hold

Depressing "DISP HOLD" button sets display time to infinite and freezes the last measurement result. A new measurement can be initiated using reset.

In the COUNT mode, the "DISP HOLD" control is used to start and stop manual totalizing.

** See definitions*

PM 6673, PM 6674, PM 6675 & PM 6676

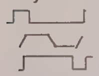
Reset

Manual via push button or electrical via input E.

Input and Output Specifications

LF-Input (Channel A)

Frequency Range: 10 Hz...120 MHz
Sensitivity:
Sine: 10 mVrms (20 Hz...120 MHz), 6 dB down at 10 Hz
Pulse: 30 mV_{pp} (0 Hz...120 MHz), minimum pulse duration 4 ns
Attenuation: Continuously variable in two ranges between x 1...x 500. Noise immunity band (hysteresis band) can be continuously adjusted over the range: 20 mV_{pp}... 10 V_{pp} nominal.
Noise Filter: Switchable 50 kHz Low Pass filter. Noise suppression ≥20dB at 500 kHz
Impedance: 1 MΩ//≤25 pF
Trigger Level: Switchable with waveform selectors for optimum triggering on signals of various duty factors.



: for duty factor of <0.25
: for duty factor of 0.25...0.75
: for duty factor of >0.75

Coupling: AC
Maximum Voltage Without Damage:
DC: 300V
AC: 260 Vrms at 1440 Hz declining to 12 Vrms at ≥1 MHz (in 10 mVrms range), 260 Vrms (in 200 mVrms range)

RF-Input (Channel B)

Frequency Range:
PM 6674: 50 MHz...550 MHz; 6 x prescaled
PM 6675: 50 MHz...600 MHz; direct gating
PM 6676: 100 MHz...1.5 GHz; 16 x prescaled
Operating Input Voltage Range:
10 mVrms ...12 Vrms
PM 6675: Sensitivity is 5 mVrms (100 MHz ... 500 MHz)
PM 6676: sensitivity above 1 GHz decreases to 30 mVrms (worst-case) or 15 mVrms (typical) at 1.5 GHz.
Impedance: 50Ω nominal; VSWR <2
Coupling: AC
AM Tolerance: 98%; minimum signal must exceed 30 $mV_{p\text{-}p}$
Maximum Voltage Without Damage: 12V; overload protection with PIN diodes

Ext. Reference and Ratio Input (Ch. D)

Frequency Range: 1 kHz...10 MHz
Sensitivity: 500 mVrms
Impedance: Approx. 2 kΩ
Coupling: AC
Max. Voltage Without Damage: 25 Vrms

Note: As external reference frequency, only 10 MHz will give correct decimal point and unit indication. With the optional frequency multiplier PM 9697 references of 1 and 5 MHz can also be accepted.

Ext. ARMING/FREQ-AVG/RESET (Ch. E)

A 3-position rear panel switch gives choice of external control over:

ARMING: In this position the counter is prevented from starting a new measurement when input E is high. A high-to-low going pulse arms the counter to start a new measurement.

Note: Arming not applicable in COUNT mode.

FREQUENCY A AVERAGE: When making reciprocal frequency or period measurements, the measurement is interrupted when input E is high. The measurement is continued again when input E is low.
To allow frequency average measurements up to 100 MHz, the automatic switching to the CONVENTIONAL mode above 10 MHz is omitted.
The effective measurement time (defining resolution and accuracy) is the sum of external gate times that occurs during the selected measurement time.
EXT. RESET-START: Electrical reset, equivalent to the front panel RESET push button. (See HOLD and RESET). Counter is reset when input E goes high. A new measurement can be made after input E has returned low.
Input Levels: *High:* ≥2V; *Low:* ≤0.5V
Input Impedance: Approx. 2 kΩ
Max. Input Voltage Without Damage: ±25V
Minimum Pulse Duration:
Arming and Frequency Avg: 500 ns
External Reset: 200 µs

Time-Base Oscillator Output

Crystal Frequency: 10 MHz
Output Level: LS-TTL compatible
Output Impedance: Approx. 4008
Coupling: DC
Overload Protection: Short-circuit proof

General Specifications

Time Base

For specifications, see table on page 358.

Display

Readout: 9 digits, 11 mm high-efficiency LEDs. Microprocessor control of display format, decimal point and unit indication: Hz, kHz, MHz, GHz, ns µs, ms and s.
Display Time: Continuously variable 80 ms... 96s plus DISP HOLD.
Gate Lamp: Indicates that main-gate is opened and measurement takes place.
ST BY: Stand-by indication with LED when instrument is not switched ON.
REMOTE: Indicates when control over counter is taken by the installed bus interface option (IEEE-488).
Low-Battery: Indication by blinking display some 15 min. before recharging is needed.

Power Requirements

These counters can be powered from: line voltage,and optional battery or external battery voltage.

Line: 115/230V ±15%; 45...440 Hz; <25 VA
Internal Battery Unit: PM 9693
External DC Source: 11.8V...28V
Line Interference: Below VDE 0871 (B) and MIL STD 461
Safety: According to IEC 348 and CSA 556 B

Dimensions and Weight

Dimensions: 210 mm W x 89 mm H x 280 mm L (8.25 in W x 3.8 in H x 11 in L)
Weight: 2.5 kg (5.5 lb)

Environmental Conditions

Temperature:
Rated Range of Use: -5°C...+50°C
Functional Operation: -10°C...+55°C
Storage and Transport: -40°C...+70°C
Humidity:
Operating: 10...90% RH, no condensation.
Storage: 5...95% RH.
Altitude/Barometric Pressure:
Operating: 5000m (15000 ft) -53.3 kN/m²
Storage: 15000m (50000 ft) -15.2 kSN/m²

Definitions

LSD Displayed:

Unit value of Least Significant Digit displayed
For Frequency <10 MHz or Period Average:

$$\text{LSD} = \frac{2.5}{\text{measuring time}} \times \frac{\text{FREQ or PERIOD}}{10^7\ \text{Hz}}$$

For Frequency >10 MHz:

$$\text{LSD} = \frac{2.5 \times \text{prescaling factor}^{(p)}}{\text{measuring time}}$$

For Ratio:

$$\text{LSD} = \frac{2.5 \times \text{prescaling factor}^{(p)} \times \text{RATIO}}{\text{measuring time} \times \text{FREQ A or B}}$$

Resolution:

Smallest increment between two measuring results, being most often 1 LSD unit. Due to arithmetic truncation the resolution can be 2 LSD units, but can then be reduced to 1 LSD unit, by doubling the measuring time.

The Resolution is 2 LSD Units:

$$\text{if: LSD} < \frac{1}{\text{measuring time}} \quad \text{(Freq. >10 MHz)}$$

$$\text{or if} \quad \frac{\text{LSD} \times \text{measuring time}}{\text{FREQ or PERIOD or RATIO}} < 10^{-7}\text{s}$$

(Freq. ≤10 MHz, Period or Ratio).

In all other cases the resolution is 1 LSD unit. All calculated LSD's shall be rounded to nearest decade (e.g. 5 ns will be 10 ns and 0.4 Hz will be 0.1 Hz) and cannot exceed the 9th digit.

Resolution:

Smallest increment between two measuring results, being most often 1 LSD unit. Due to arithmetic truncation the resolution can be 2 LSD units, but can then be reduced to 1 LSD unit, by doubling the measuring time.

Rel. Trigger Error

For any Waveform:

$$\frac{\text{peak-to-peak noise voltage}}{\text{signal slope (V/s)} \times \text{measuring time}}$$

For Sinewave:

$$\frac{1}{\text{FREQ} \times \text{measuring time} \times \pi \times \text{S/N ratio}}$$

Example: For S/N ratio of 100 (40 dB) and 1 second measuring time, the trigger error is:

$$\frac{3 \times 10^{-4}}{\text{FREQ}}$$

IEEE-488 Interface Data

IEEE Interface Option PM 9696: Can be supplied fitted (to order), or retrofitted in the field.
Connector: 24-pole: address set by switches
Output Data: Measuring data including function code, overflow and range. Status data, generated at serial poll or after instruction, including full programming status data and function status
Output Rate: 10...20 readings per second
Input Data: Programing data for all manually controllable functions except input trigger functions

Included with the instrument: Operating manual, line cord

Ordering Information

Models

January 1989 prices

PM 6670 120 MHz timer/counter, 100 ns single shot resolution, standard oscillator 5 x 10^{-7}/month	$1075
PM 6671 As PM 6670 but with extended facilities	1195
PM 6672 As PM 6670 but with extended facilities and frequency range to 1GHz	1495
PM 6673 120 MHz counter, standard oscillator 5 x 10^{-7}/month	975
PM 6674 As PM 6673 but with frequency range to 550 MHz	$1250
PM 6675 As PM 6673 but with frequency range to 600 MHz (direct gated)	1395
PM 6676 As PM 6673 but with frequency range to 1.5 GHz	1395

Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit /suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface

Input Frequency Option:

/0-- 120 MHz for PM 6670, 6671, 6673	N/C
/1-- 600 MHz (direct gated) for PM 6675 only	N/C
/3-- 550 MHz for PM 6674 only	N/C
/4-- 1 GHz for PM 6672 only	N/C
/5-- 1.5 GHz for PM 6676 only	N/C

Reference Oscillator Option:

/-1- Standard	N/C
/-2- TCXO (PM 9678B/01)	add 225
/-3- Ovenized Crystal Oscillator (PM 9679E/01)	add 450
/-4- Very High Stability Crystal Oscillator (PM 9690/01)	add 645
/-5- Ultra High Stability Crystal Oscillator (PM 9691/01)	add 845
/-8- Externally Referenced Frequency Multiplier (PM 9697/00), with Standard Oscillator only	add 175

Interface Option:

/--1 Standard, non GPIB IEEE-488	N/C
/--3 Battery (PM 9693/00) for all except PM 6670	add 250
/--4 BCD Output & Display Offset (PM 9694/00) for all except PM 6670	add 325
/--5 Analog Output (PM 9695/00) for all except PM 6670	add 405
/--6 GPIB IEEE-488 (PM 9696B/00) for all except PM 6670	add 300

Example, Ordering Configuration:

To order the PM 6671 with standard 120 MHz input, temperature compensated oscillator, & no interface, select:

		Model	Price
		PM 6671	$1195
Configuration			
Option Suffix -	Input	/0--	N/C
	Oscillator	/-2-	225
	Interface	/--1	N/C
Yields Complete Model Number		PM 6671/021	1420

Options and Accessories

PM 9669/01 19-in Rackmount Adapter to fit one instrument	$75
PM 9669/02 19-in Rackmount Adapter to fit two instruments	110
PM 9672/70 Carrying Case	70
PM 9678B/01 Temp. Compensated Oscillator	225
PM 9679E/01 Ovenized Crystal Oscillator	450
PM 9690/01 Very High Stability Oscillator	645
PM 9691/01 Ultra High Stability Oscillator	845
PM 9693/00 Battery Unit	250
PM 9694/00 BCD Output and Display Offset Unit	325
PM 9695/00 Analog Recorder Output	405
PM 9696B/00 IEEE-488 Bus Interface	300
PM 9697/00 External Reference Frequency Multiplier	175
PM 9581/01 50Ω Feed-Through Termination 3W	65
PM 9585/01 50Ω Feed-Through Termination 1W	30

Note: PM 6670 cannot be equipped with options PM 9693, PM 9694, PM 9695 and PM 9696.
PM 6671...PM 6676 can be equipped with max. one of these options.
The PM 9697 multiplier can only be installed simultaneously with the /01 oscillator. For installation in other versions the oscillator has to be removed first.

Service & Support

Warranty

One-year product warranty. See Page 470 for further information on warranty terms and conditions.

The above configurations meet North American power requirements. For other power options, see page 491.

1900A

(NSN 6625-01-049-1844) **1900A**

1900A Multifunction Counter

- Frequency, period, period averaging and totalize measurements
- 6-digit display
- 1 MHz low-pass filter
- Available with full parallel BCD output and rechargeable battery

Fluke's versatile 1900A Multi-Counter provides frequency, period, period averaging, and totalize measurements over a wide range of applications. In frequency mode, the 1900A verifies the accuracy of signal sources such as generators, oscillators and transmitters. Period mode measures the time duration of a single input cycle, which allows high resolution of low frequency measurements. In period average mode, the counter averages cycle time over 10, 100 or 1000 cycles for still finer resolution. Totalize mode is similar to frequency mode except that the signal gate is open and closed deliberately, a feature useful for totalizing the cycles in a single RF burst or counting electromechanical relay contact bounce. A selectable 1 MHz low-pass filter provides input signal conditioning to give accurate low frequency measurements in electrically noisy environments. A selectable 10:1 attenuator is provided.

A rechargeable battery is included in Model 1900A-01, providing up to 4 hours of operation with a 14 hour recharge time.

Specifications

Technical Specifications

Frequency: 5 Hz to 80 MHz. Four manually-selected gate times of 10 ms (100 Hz resolution), 100 ms (10 Hz resolution), 1s (1 Hz resolution), and 10s (0.1 Hz resolution). Autorange position automatically seeks to fill all 6 digits but will not select a gate time greater than 1s (1 Hz resolution)

Period: 5 Hz to 1 MHz. Manual selection of single period or 3 period-averaging ratios:

10^0 single period (100 ns resolution)
10^1 periods averaged (10 ns resolution)
10^2 periods averaged (1 ns resolution)
10^3 periods averaged (100 ps resolution)

Autorange position automatically seeks to fill all 6 digits but will not select a period average of greater than 10^2 averages

Totalizing: Accumulates up to 999999 counts, then activates overflow indicator

Sensitivity: 25 mV, typically 15 mV rms sine wave, 5 Hz to 80 MHz. Frequency and totalize: 200 mV peak-to-peak pulse amplitude with minimum pulse width of 20 ns. Duty cycle <10%. Period: 200 mV peak-to-peak pulse amplitude with minimum pulse width of 200 ns. Duty cycle <10%

Input Impedance: 1 MΩ, ≤30 pF

Noise Filter: 1 MHz (3 dB point) lowpass

Attenuator: Decreases sensitivity by 10

Overload: 250V rms 5 Hz to 1 kHz decreasing to 20V at 80 MHz

Timebase

Frequency:	10.00 MHz
Aging Rate:	<±5 x 10^{-7}/mo
Temperature Accuracy:	
0°C to 50°C	<±5 x 10^{-6}
Line Variation: (±10%)	<±1 x 10^{-7}

Display: 6-digit LED, leading zero suppression. Time between successive measurements is 200 ms plus measurement time.

Annunciation: MHz, kHz, ms, µs, overflow

Autorange: In both frequency and period modes, autoranging includes a unique 20% hysteresis in its switching thresholds to eliminate redundant up-range/down-range commands. This allows measurements to be made on signals containing large amounts of FM and øM. Hysteresis memory can be reset by depressing the "Reset" button

General Specifications

Autoreset: A new measurement sequence is started every time a front panel button is activated

Temperature: 0°C to +50°C operating (40°C max in battery version if being charged while operating); -40°C to +60°C, non-operating

Power: 115 or 230V ac ±10% (100V ac available) 50, 60 or 400 Hz. 6.5W line model, 8.5W battery model

Fuses: 1/8A line version, 1/2 amp slow-blow battery version

Size: 6 cm H x 22 cm W x 25 cm D (2.5 in H x 8.5 in W (including handle) x 10 in D)

Weight: 1.2 kg (2.75 lb), 1.9 kg (4 lb) with batteries

Included: Instruction manual, power cord. Order Y9111, Y9112 coaxial cable(s) and Y9103 50Ω Terminator separately

Ordering Information

Models

January 1989 prices

1900A Multifunction Counter	$510
1900A-01 w/Rechargeable Battery	695

Accessories (Also see page 485)

A53 Whip Antenna	30
C86 Carrying Case, Molded Plastic	20
Y7201 Attenuator/Filter	65
Y8205 Soft Carrying Case w/shoulder strap	35
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω	20
Y9112 6 ft (1.85m) Coaxial Cable, 50Ω	20
Y9103 50Ω Feed-thru Terminator	35
M00-100-714 Dust Cover	10
M00-200-611 3" Rack Adapter, Offset	50
M00-200-612 3" Rack Adapter, Center	50
M00-200-613 3" Rack Adapter, Dual	60

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

1910A, 1911A & 1912A

1910A

1910A, 1911A & 1912A Multifunction Counters

- Frequency, period, period averaging and totalize measurements
- 7-digit display
- Autoranging
- Autoreset
- Instant warning when input signal falls below sensitivity threshold (Models 1911A and 1912A)
- Rechargeable battery pack version

These rugged counters are at home on the production line, in the lab, or in the field and do the work of counters costing much more. They measure frequencies to 125 MHz, 250 MHz or 520 MHz (depending on model), period of signals to 2 MHz, period average to 10 ps resolution and totalize to 9,999,999 counts.

Autorange

Full autoranging is supplemented by selectable four-range manual operation. In autorange, the display is automatically filled to a maximum 7-digit readout. A unique hysteresis capability eliminates undesirable up-and-down ranging for between-range signals.

Autoreset

This automatic feature is activated every time you select a new range or function, which means you never have to wait for a second reading, the first one in the new measurement sequence is always correct. Autoreset saves time and reduces errors.

Automatic Clean Dropout

The 1911A and 1912A Channel B input has a circuit which automatically monitors the input and gives you instant warning in the form of zero readout whenever your input signal falls below the sensitivity threshold of the trigger circuit. When the signal level returns to an acceptable level, the counter locks on for a correct reading.

Sensitivity

A basic sensitivity of 15 mV, backed by Fluke's conservative design margin, guarantees you will get reliable, solid readings every time. In practice, a typical sensitivity of 10 mV will be experienced.

Versatile Timebases

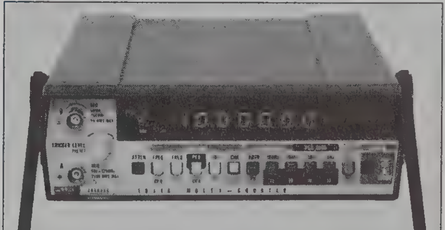
The standard 0.5 ppm per month timebase assures excellent long term stability for bench, production or field use. A convenient rear panel external timebase input jack and switch let you operate from your own 10 MHz frequency standard at any time. Choice of optional time bases with improved aging rates and temperature stabilities allows you to purchase only as much stability as you'll need in your applications.

Input Signal Conditioning

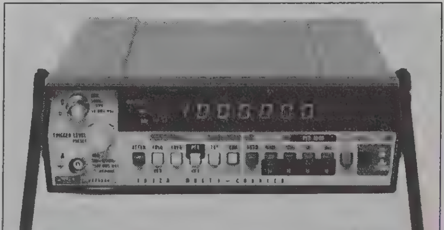
Each counter offers trigger level and attenuator controls which operate over the dynamic range of the input to permit accurate readings in the presence of noise. Even ringing TTL signals can be accurately measured. In addition, the 1911A offers a separate 50 ohm input for 50 MHz to 250 MHz and the 1912A does the same but goes to 520 MHz.

Battery Portability

All three counters are available with rechargeable batteries for field portability. Order 1910A-01, 1911A-01, or 1912-01. Four hours minimum operation gives you plenty of opportunity to solve those tough field service problems.



1911A



1912A

1910A, 1911A & 1912A

Specifications

Model	Channel	Operating Range		Sensitivity	Input Impedance	Overload (Max Input Voltage)	Prescale Factor
		Frequency	Period				
1910A	A	5 Hz-125 MHz	500 ns-0.2s (5 Hz-2 MHz)	15 mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 MΩ/30 pF, ac coupled	dc + ac; <360V pk; 250V rms, 5 Hz - 1 kHz 10V rms above 1 kHz	–
1911A	A	5Hz 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 mΩ/30 pF ac coupled	dc + ac;<360V pk; 250V rms, 5 Hz - 1kHz 10V rms above 1 kHz	–
	B	50 MHz-250 MHz	–	15 mV rms, 50 MHz - 175 MHz 30 mV rms, 175 MHz - 250 Mhz	50Ω, VSWR <2.5:1	dc + ac: <100V pk; 5V rms, fuse protected	2
1912A	A	5 Hz - 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 MΩ/30 pF ac coupled	dc + ac; <360 V pk; 250V rms, 5 Hz - 1 kHz 10V rms above 1 kHz	–
	B	50 MHz-520 MHz	–	25 mV rms, 50 MHz - 520 MHz	50Ω, VSWR <2.5:1	dc +ac: <100V pk; 5V rms, fuse protected	4

Specifications

Technical Specifications

Ch. A Attenuator: X1, X10 (approx.)

Ch. A Trigger Level: ±0.5V range

Ch. A Totalize: 1 to 9,999,999 counts

Frequency Accuracy: Timebase accuracy ±1 count

Period Accuracy: Frequency accuracy plus trigger error*

* *Trigger error is less than 0.3% of one period ÷ periods averaged for sinewaves of 40 dB signal-to-noise ratio or better and amplitude equal to sensitivity of counter*

Frequency Resolution: 0.1 Hz, 1 Hz, 10 Hz, 100 Hz, manually selected. Autorange automatically seeks to fill 7 digits but will not select gate time <1 second

Period Resolution: 100 ns, 100 single period; 10 ns, 101 period averaged; 1 ns, 102 periods averaged; 100 ps, 103 periods averaged. Autorange automatically seeks to fill 7 digits; if input frequency is high enough, may select 104 periods averaged (10 ps resolution) but will not select measurement time <1 second

Option Specifications

TCXO Options (-03, -04)

Timebase Selection Guide

Type (10 MHz)	Aging Rate	Line Variation (±10%)	Temperature Accuracy 0-50°C
Standard	±5 x 10^{-7}/mo	±1 x 10^{-7}	±5 x 10^{-6*}
Option -03	±3 x 10^{-7}/mo	±2 x 10^{-8}	±2 x 10^{-6*}
Option -04	±3 x 10^{-7}/mo	±2 x 10^{-8}	±5 x 10^{-7*}

**p-p variation*

General Specifications

Display: 7-digit LED, leading zeros suppressed

Annunciation: MHz, kHz, msec, +sec, overflow

Operating Temperature: 0°C to 50°C (line models). 0°C to 40°C (battery models) when operating and charging

Storage Temperature: -40°C to +70°C (line models), -40°C to +60°C (battery models)

External Timebase Input

Frequency: 10 MHz to 300 kHz (typical)

Amplitude: 300 mV rms, 5V p-p max

Input Impedance: <1 kΩ

Power, Line Models: 100, 115, or 230V ac ±10%, 48 Hz to 440 Hz, 8W maximum

Power, Battery Models

100V ±10%, 48 Hz to 52 Hz, 8.5W max
100V ±10%, 58 Hz to 62 Hz, 8.5W max
115V ±10%, 58 Hz to 62 Hz, 8.5W max
230V ±10%, 48 Hz to 52 Hz, 8.5W max

Note: Voltage and frequency must be specified at time of order

Time (between successive measurements): 200 ms plus measurement time

Size: 6.4 cm H x 21.7 cm W x 27.1 cm D (2.52 in H x 8.55 in W x 10.65 in D)

Weight: 1.5 kg (3.2 lb) max, for line models. 2.2 kgm (4.8 lb) max for battery models

Safety: Factory Mutual 3820 approved, CSA 556B certified

Included: Instruction manual, power cord. Order Y9111 or Y9112 coaxial cable(s) and Y9103 50-Ohm Terminator separately

Y7201 Attenuator/Filter

The Y7201 is a combination variable attenuator and selectable low pass filter which can be used for input signal conditioning on all counters. Typical specifications are:

Input Impedance: 47 kΩ

Attenuation Range: X5 to X100, continuously adjustable

Low Pass Filter: 1 kHz, 20 kHz or 100 kHz, switch-selectable

Maximum Input: 30V ac

Ordering Information

Models

January 1989 prices

1910A 125 MHz Multifunction Counter	$685
1910A-01 W/Rechargeable Battery	845
1911A 250 MHz Multifunction Counter	840
1911A-01 W/Rechargeable Battery	975
1912A 520 MHz Multifunction Counter	925
1912A-01 W/Rechargeable Battery	1050

Specify line voltage and frequency if other than 60 Hz and 115V ac

Options (for 1910A, 1911A & 1912A)

19XXA-03* 2 ppm TCXO	245
19XXA-04* 0.5 ppm TCXO	305

**Factory installation only.*

Accessories (Also see page 485)

A53 Whip Antenna	30
Y7201 Attenuator/Low Pass Filter	65
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω BNC to BNC	20
Y9103 508 BNC Feed-thru Terminator	35
C86 Carrying Case, Molded Plastic	20
Y8205 Soft Carrying Case w/shoulder strap	35
M00-200-611 3" Rack Adapter, Offset	50
M00-200-612 3" Rack Adapter, Center	50
M00-200-613 3" Rack Adapter, Dual	60

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

PM 6669

IEEE-488

PM 6669

PM 6669 Multifunction High-Resolution Frequency Counter

- Unrivalled price/performance
- High resolution reciprocal counting
- Error-free triggering
- High stability MTCXO; $2x10^{-7}$ over 0°..50°C with pushbutton calibration
- Eight measuring modes including PULSE WIDTH
- Versatile use with the GPIB interface or battery operation
- 1.3 GHz RF-input

Introduction

The PM 6669 is a multi-function frequency counter, spanning the frequency range from 0.1 Hz...120 MHz, or optionally up to 1.3 GHz. Measuring functions include FREQUENCY, frequency deviation FREQ A-A_0, FREQ A/A_0, RPM, PERIOD, TOTALIZE counts and PULSE WIDTH.

The built-in microprocessor uses the reciprocal frequency-counting technique to yield high resolution measuring results under all conditions even on low frequency measurements.

Measuring accuracy is enhanced by the high-performance front-end, providing continuous adjustment of sensitivity and noise immunity. Accuracy can be further increased with the optional high stability time-base.

The instrument is designed to fulfill a broad range of needs with a full range of options, including a GPIB bus interface for systems use and a battery pack for line independent field use.

High Stability MTCXO

Until now, choice of the crystal timebase oscillator, which determines the final accuracy of the counter, was only between the low-cost uncompensated standard crystal oscillators, medium price TCXOs (temperature compensated crystal oscillators) and high price, high stability oven-controlled oscillators.

Now, Philips has developed a mathematically compensated crystal oscillator which costs the same as a normal TCXO yet has a stability of 2 x 10^{-7} (0...50°C), fully comparable with an oven stabilized oscillator.

This new oscillator is called the MTCXO or Mathematically Temperature-Compensated Crystal Oscillator. It has an associated non-volatile memory, in which are stored the frequency deviations from the factory measured temperature dependent frequency curve at each temperature. During a measurement, the temperature of the crystal is measured, the deviation for that temperature is retrieved from the memory and the result is automatically compensated before display. In addition, because the temperature of the crystal is always compensated for each measurement, no warm up time is required for high accuracy measurement.

If ultra-high stability calibrations are needed, the PM 6669 is provided with an input for an external reference frequency source.

Unprecedented Counter Value

The precision and stability of the MTCXO oscillator isn't the only way that PM 6669 sets new standards. A durable and stable metal cabinet that provides excellent RFI shielding; a big benefit over the cheaper plastic cabinets found in many other instruments.

PM 6669 also has high-sensitivity input circuitry, with automatic triggering on all input waveforms, continuously variable attenuation and a switchable low-pass filter for noise reduction all features normally found only in higher-priced counters.

PM 6669 also offers an optional GPIB/IEEE-488* bus interface that provides full remote programmability of all major functions, making it probably today's lowest cost programmable precision counter.

And finally, PM 6669 uses Philips' state-of-the-art electronics technology throughout, including a new LSI single-chip counter which, together with a single-chip microprocessor, forms the complete counter logic. SMD (surface-mounted device) technology is also used for precise, highly automated assembly.

Our advanced technology results in compact construction, low dissipation and very high reliability. All these benefits, in combination with PM 6669's very attractive price level, add up to an unprecedented combination of counter performance and value.

High-Resolution Measurements

Synchronized multiple-period measurements, with computation of the reciprocal value, allow high-resolution measurements on signals of all frequencies. PM 6669's microprocessor eliminates traditional ±1 input cycle errors, resulting in a measurement result of at least 7 digits per second of measuring time, regardless of the input frequency. This capability eliminates the need for the long gate times or period measurements which are normally required to obtain high resolution.

A full 9-digit display allows complete presentation of the measurement result, while unstable or insignificant display digits can be blanked to avoid erroneous readings of the display.

Measuring accuracy is further assured by front-end circuitry that gives error-free triggering for all input waveforms. The low-pass filter effectively

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

suppresses spikes, noise and interference, and even rejects spurious HF components that are stronger than the input signal itself. In addition, the wideband, continuously variable attenuator allows optimum matching of trigger sensitivity and noise immunity over a wide dynamic range from 20 mV p-p to 10V p-p.

Frequency Range up to 1.3 GHz

The standard PM 6669 has a measuring range that extends from 0.1 Hz up to 120 MHz. Optionally available is a high-frequency input that extends the input up to 1.3 GHz, for example for telecommunications applications. This input can handle voltages from 10 mV rms up to 12V rms for maximum versatility in operation.

The Versatile Counter

PM 6669's wide frequency bandwidth and high-precision performance make it the ideal counter for a very wide range of measuring applications: on the test bench, telecommunications and general purpose lab environments, in IEEE-488 bus systems and with the optional battery pack, in the field.

A selection of special purpose options can all be user-retrofitted as and when needed. This choice allows exactly the right instrument configuration to be selected for each application, without the need to buy unnecessary features. These options include high-stability timebase, 1.3 GHz input, GPIB (IEEE-bus) interface, rack mount assembly, carrying case and battery pack.

Specifications

Measuring Functions

Frequency A or B

Range:
Freq A: 0.1 Hz...120 MHz. Typically...160 MHz
Freq B: 70 MHz...1.3 GHz (optional)
Mode: Reciprocal frequency counting

$$\text{LSD displayed} \quad \frac{2.5 \times 10^{-7} \times \text{frequency}}{\text{measuring time}}$$

Frequency A/A_0

A Frequency A measurement is done. The measured frequency is divided by the constant A_0 before display. A_0 is read from channel A and is stored using the STORE A_0 button. The resolution of the displayed ratio is determined by the Frequency A measurement. At power-on A_0 is set to 1 (default).

Frequency A-A_0

A Frequency A measurement is done. The value of constant A_0 is subtracted from the measured frequency before display. A_0 is read from channel A and is stored using the STORE A_0 button. The resolution of the displayed difference is determined by the Frequency A measurement. At power-on A_0 is set to 0 (default).

RPM A

A Frequency A measurement is done. The measured frequency is multiplied by 60, and shown on the display as revolutions per minute (rpm).
Range: 0.1 Hz...12 MHz (6 rpm...720 x 10^6 rpm)

Period A

Range: 8 ns...2x10^8s. For sinewave signals, period must not exceed 0.1s
Mode: Single period measurement (SINGLE) and average period measurement (at 0.2, 1 and 10s meas times).
LSD Displayed
Single period measurement: 100 ns (Time <100s)
Period average measurement:

$$\text{Period average measurement:} \quad \frac{2.5 \times 10^{-7}\ \text{period}}{\text{measuring time}}$$

Totalize A

The event counting is controlled by the Start/Stop button. Sequential start-stop counts are accumulated. Reset closes the gate and resets the counter to zero.
Range: 0...1 x 10^{15} with indication of K or M (Kilo-pulses or Mega-pulses). The result is truncated if out of display range
Frequency Range:
Sine: 10 Hz...12 MHz;
Pulse: 0 Hz...12 MHz

Width A

A positive Pulse Width measurement on a repetitive signal is done.
Range: 100 ns...2 x 10^8s
LSD Displayed: 100 ns (Width <100s)

Definitions

LSD Displayed

Unit value of the least significant digit displayed. All calculated LSDs (see measuring functions section) should be rounded to the nearest decade (e.g. 0.3 Hz is rounded to 0.1 Hz and 5 Hz to 10 Hz) and cannot exceed the 9th digit.

Resolution

Smallest increment between two measuring results on the display, due to the ±1 count error.
Freq A, B, Period A: Resolution can be 1 LSD unit or 2 LSD units. If

$$\frac{\text{LSD measuring time}}{\text{FREQ or PERIOD}} < 10^{-7}$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability)

SINGLE: Period A and Width: Resolution equals 1 LSD unit

Inaccuracy

Inaccuracy depends on the following factors:

$$\pm \frac{\text{resolutions}}{\text{FREQ, PERIOD or WIDTH}}$$

± rel trigger error ±
± rel time base error

Relative Trigger Error:

$$\pm \frac{\text{noise voltage A (Vpp)}}{\text{signal slope A (V/s) x meas time}}$$

Relative Time Base Error:

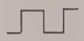
$$\pm \frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$$

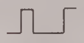
For WIDTH measurements on non-symmetrical signals, the error caused by wrong trigger level setting should be added.

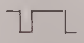
Input Specifications

Input A

Frequency Range: 10 Hz...120 MHz, typically...160MHz
Sensitivity:
Sine: 10 mV rms, 10 Hz...120 MHz
Pulse: 30 mV pp, 0 Hz...120 MHz Minimum pulse duration: 4 ns
Sensitivity decreases to 30 mV rms at 160 MHz typically
Coupling: AC
Impedance: 1 MΩ/30 pF
Attenuation: Continuously variable in two ranges between x1...x400
Filter: Switchable 50 kHz low pass noise filter with a suppression of 20 dB at 200 kHz
Trigger Levels: 3 different levels for triggering on signals with various duty factors, and AUTO


: symmetrical input signals, should be selected for input signals with a duty factor of 0.25...0.75.


: positive pulses, for input signals with duty factor <0.25.


: negative pulses, for input signals with duty factor >0.75.

AUTO Trigger Level: The counter will make test settings and automatically select the best trigger level setting. Auto requires repetitive signals with a repetition rate <100 Hz. Auto is not active in Totalize A measurements
Maximum Voltage Without Damage: 350V (DC and AC peak); DC to 440 Hz falling to 11V rms at 1 MHz

Input B (Option PM 9608B):

Frequency range: 70MHz...1.3GHz
Coupling: AC
Operating input voltage range:
10 mV rms...12V rms; 40...900MHz
15 mV rms...12V rms; 900...1100MHz
40 mV rms...12V rms; 1100...1300MHz

AM Tolerance: 94% at max 100 kHz modulation frequency. Minimum signal must exceed minimum operating input voltage requirement.
Input impedance: 50Ω nominal, VSWR <2:1
Max voltage without damage: 12 Vrms; overload protection with pin diodes

Input B (Option PM 9615):

Not available in all countires
Frequency range: 100MHz...1.0GHz
Operating input voltage range:
10 mV rms...12 Vrms; 100...900 MHz
15 mV rms...12 Vrms; 900...1000 MHz
For all other specifications, see PM 9608B

Input C:

(External reference input). The input automatically detects when a suitable external reference signal is connected. The use of an external reference signal is indicated on the display
Input Frequency: 10 MHz ±0.1 MHz
Coupling: AC
Sensitivity: 500 mV rms
Input Impedance: Approximately 300Ω at 10 MHz
Max Input Voltage: 15V rms

General Specifications

Power Requirements

Line Voltage: 115 or 230V rms 46...440 Hz, ±15% (<20 VA including all options)
Safety: According to IEC 348 Class I and CSA 5568
Line Interference: Below VDE 0871 B and MIL-STD-461
Battery Unit: See PM 9605 Option

Timebase

Crystal Version:	Standard	MTCXO
Stability Against:		
Aging:		
per month	$<5x10^{-7}$	$<1x10^{-7}$
per year	$<5x10^{-6}$	$<5x10^{-7}$
Temperature Changes 0...50°C	$<1x10^{-5}$	$<2x10^{-7}$
Line Voltage Changes 10%	$0<1x10^{-8}$	$<1x10^{-9}$

Display

Readout: 9 digit LCD display with unit and cursor indication
GATE: Indicates that the counter is busy measuring
REMOTE: Indicates when control over the counter is taken by an installed GPIB interface PM 9604

Dimensions and Weight

Size: 186mm W x 88mm H x 270mm D (7.3 in W x 3.5 in H x 10.6 in D)
Weight: 2.1 kg (4.6 lb)

Cabinet: The counter is housed in a metal cabinet, to achieve good EMC characteristics and mechanical stability

Environmental

Temperature
Operating: 0°C...+50°C
Storage: -40°C...+70°C
Altitude:
Operating: 5000m (53.3 kN/m2
Storage: 15,000m (15.2 kN/m2)
Humidity:
Operating: 10%...90% RH (no condensation)
Storage: 5%...95% RH

Auxiliary Functions

Reset

The RESET-button has three functions

1. **RESET**. Starts a new measurement. The settings are not changed.
2. **LOCAL**. Makes the counter go to LOCAL operation, when in remote operation (unless Local Lock-Out is programmed).
3. **START/STOP**. Opens/closes the gate in TOTALIZE A MAN mode.

Measuring Time

A measuring time of 0.2s, 1s, 10s or Single can be selected.

Displ Hold/Store A_0

The Displ Hold/Store A_0 button has two functions:

1. **DISPL HOLD:** The current measuring result is frozen on the display. A new measurement starts when Reset button is pressed.
2. **STORE A_0:** This function is active in Frequency A measurements only. When the button is pressed for >1s, the result on the display is stored as the constant A_0, which is used for the calculation of frequency difference ($A-A_0$) and ratio (A/A_0).

Blank Digits

This function blanks any number of least significant digits on the display, in order to hide unstable display digits

Optional Accessories

GPIB-Interface PM 9604

Mounting: Inside counter cabinet
Interface Functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2
Programmable Device Functions:
Measuring functions
Measuring time
Trig level offset selection
Trigger slope
Manual totalize gate control
Output separator selection
Device clear
Device trigger
Set time-out
High speed dump
Short output format
Free run/triggered measurements
Set SRQ-mask
Program data out
Device identity
Max. Data Output Rate:
Normal Mode: Approx 5 readings/s
High Speed Dump: Approx 100 readings/s
The highest output rate is obtained at SINGLE measuring time
High Speed Dump: The contents of the counting registers are transferred to the controller without being processed by the counter; the processing must be done in the controller. Max. data output rate: 100 readings/s.
Output Time for Measuring Data
Normal Mode: Approx 9 ms (20 bytes)
High Speed Mode: Approx 4 ms (15 bytes)
Response Time for Addressing: Approx 1 µs
Response Time for Trigger Command (GET): Approx 10 ms
Typical Read Time for Programming Data: Approx 1 ms/byte

Battery Unit PM 9605

The PM 9605 is a rechargeable battery unit for mounting inside the counter. The unit contains a standard 6V sealed lead-acid battery.
Battery Capacity (20°C): Approx 15 Wh, sufficient for 2 hours continuous counter operation
Recharging: The battery unit is continuously recharged from the counter in line mode operation (overcharge protection circuitry is built-in)
Recharging Time: 5 hours to approx 75% of full capacity
Battery Protection: Overcharge protection and auto shutoff to protect the battery from deep discharge
Temperature
Operating: 0°C...+40°C
Storage: -40°C...+50°C
Weight: 0.8 kg (1.7 lb)

Rackmount Kit PM 9606

The PM 9606 rack kit is designed for use with the PM 6665/6/9 family of counters. The HM 9609/01 allows mounting of one counter on the left of the rack and a blank panel or a Philips PM 2534/35 DMM on the right.

Carrying Case PM 9609

The PM 9609 is a leather-like carrying case,for protection of the counter during transportation.
Included with the instrument: Operator Manual, line cord.

PM 6669

Ordering Information

Model

January 1989 prices

Model	Price
PM 6669 120 MHz Universal Frequency Counter	$775

Optional Configurations

When ordering, select basic "PM" model desired from above, plus construct a 3-digit/suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.

Input Frequency Option

Option	Price
/0-- Standard 120 MHz	N/C
/4-- 1.3 GHz (PM 9608B/00)	add 310

Reference Oscillator Option

Option	Price
/-1- Standard	$N/C
/-3- MTCXO (PM 9607/00)	add 240

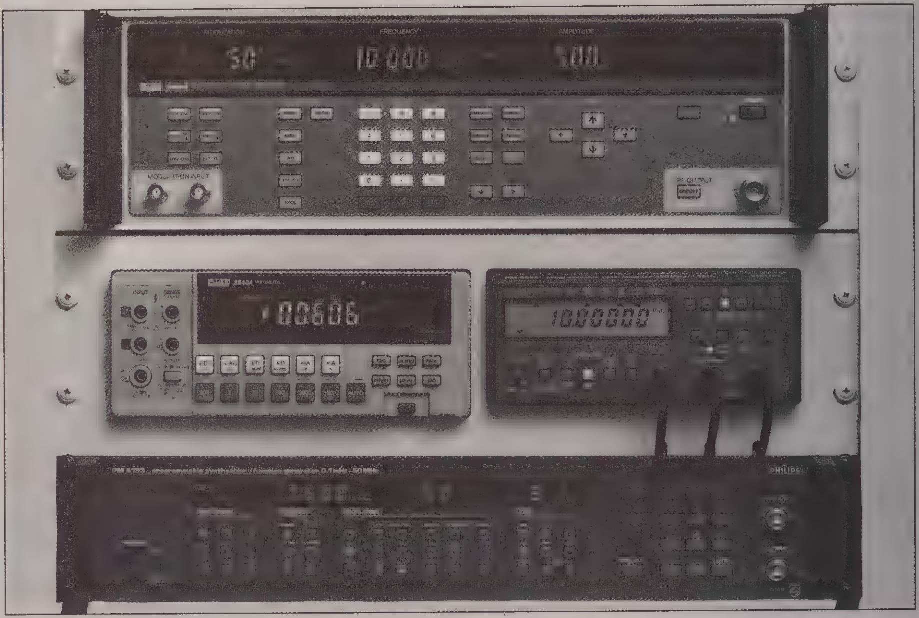
Interface Option

Option	Price
/--1 Standard line voltage, non GPIB IEEE-488	N/C
/--3 Battery (PM 9605/00)	add 245
/--6 GPIB IEEE-488 (PM 9604/00)	add 295

Example, Ordering Configurating

To order the PM 6669 with standard 120 MHz input, MTCXO Oscillator, and no interface, select:

		Price
Model	PM 6669	$775
Configuration		
Option Suffix - Input	/0--	N/C
Oscillator	/-3-	240
Interface	/--1	N/C
Yields Complete Model Number	PM 669/031	1015



Options & Accessories

Item	Price
PM 9604/00 GPIB Interface	295
PM 9605/00 Battery Unit	245
PM 9607/00 MTCXO Time Base	240
PM 9608B/00 1.3 GHz HF-Input	310
PM 9609 Carrying Case	75
PM 9581/01 50Ω Termination, 3W	65
PM 9585/01 50Ω Termination, 1W	30
HM 9606/01 Rack kit for PM 6669	90
HM 9606/00 Rack kit for PM 6669 and 8840/2 or PM 2534/35 DMM	95

All options can be field installed by the user.

Note: Options PM 9604 and PM 9605 cannot be installed together in a PM 6669 Counter.

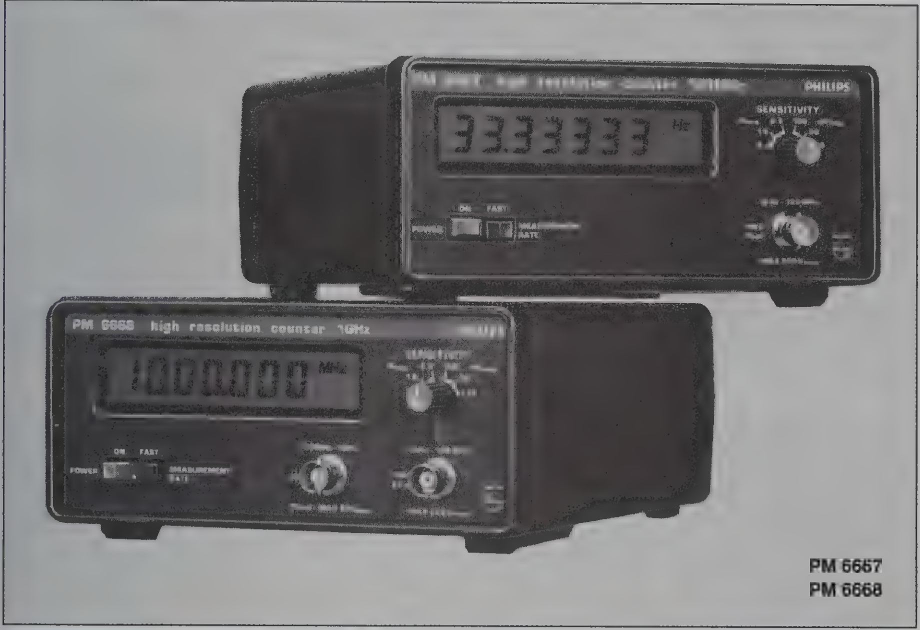
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 6667 & PM 6668



PM 6667
PM 6668

PM 6667/PM 6668 Reciprocal Frequency Counters

- High resolution computing counters
- Built-in intelligence for easy operation
- Auto triggering on all waveforms and duty cycles
- 15 mVrms sensitivity
- High-stability crystal oscillators: 10^{-7}/month
- Clear high-contrast liquid crystal display
- Line and battery operation

The microprocessor-controlled, high resolution counters PM 6667 and PM 6668 span a wide frequency range of 10 Hz to 120 MHz and 10 Hz to 1 GHz, respectively, with excellent economy. Operation is fast and the available computing power provides very high resolution capabilities normally associated with more expensive instruments.

The design incorporates an advanced technology microprocessor and dependable, large-scale C-MOS digital circuitry with fully integrated front ends which will handle a wide range of input signal voltages. Thus, the benefits of electronic performance are accompanied by a vastly reduced component count. As a result, reliability and performance are increased, size and cost reduced.

Automatic Triggering on all Waveforms

No counter is better than its front end circuitry, therefore special attention has been given to facilitate accurate and easy triggering. The multi-step attenuator allows attenuation of noisy input signals, giving a noise-immunity up to 10 dB better than with normal x 10 attenuators.

Another state-of-the-art feature is automatic trigger level setting. Depending on the input signal waveform, the counter sets automatically the required (+, 0, -) trigger level. Correct triggering is ensured without tiresome manual adjustments, for sinewaves and also for both high and low duty cycle pulses. In addition to these advanced features, the PM 6668 1 GHz front end has automatic PIN-diode attenuation, featuring automatic triggering and excellent excessive input signal tolerance.

High Resolution Computing Counter

By making a multiple period measurement and computing the reciprocal value, these counters perform high resolution frequency measurement on low frequency signals.

The microcomputer thus eliminates the traditional ±1 input cycle error and avoids the need for long gate times or period measurements or the limitations of phase-locked frequency multipliers.

Choice of two measurement times optimizes the measurement rate to the application. In the NORMAL mode, a seven digit resolution measurement is made every one second.

The FAST mode allows the user to follow changing frequency values (as for circuit trimming) and gives a full six digit resolution every 200 ms.

Greater User Convenience

In addition to automatic triggering, these counters bring excellent readout convenience by eliminating manual range selection. Independent of the input frequency, maximum resolution is assured, without any risk of overflow.

This capability plus indication of Hz, kHz, MHz and proper decimal point positioning is accomplished by the microprocessor. Easy readout is ensured by the clear, high-contrast liquid crystal display with large 11.5 mm digits.

Ideal for Field Use

Both counters are packed in a rugged, high temperature and impact resistant polyphenylenoxide case, containing a completely shielded metal inner construction.

The lightweight yet compact construction together with an optional battery pack and carrying case make these counters ideal for portable field use. A full battery charge gives approx. 5 hours of uninterrupted operation.

Some 15 minutes before recharging is needed, a low battery indication 'LO BAT' is given on the LCD display.

Self-Diagnostics

After switch-on a self test routine is executed. Should an error be detected, it is shown on the display by a diagnostic code, explained in the manual.

Quality without Compromise

These compact counters have been designed to the highest possible reliability standards. They employ a PHILIPS CMOS LSI and a single chip microcomputer that contribute to the excellent MTBF of 40000 hours.

Specifications

Frequency Measurements

Frequency Range
PM 6667: 10 Hz ... 120 MHz.
PM 6668: 10 Hz ... 1 GHz

PM 6667 & PM 6668

LSD Displayed
The unit value of the Least Significant Digit displayed is:
In Normal Display Mode:

$$\frac{\leq 5}{10^7} \times \text{FREQUENCY}$$

In Fast Display Mode:

$$\frac{\leq 2.5}{10^6} \times \text{FREQUENCY}$$

(rounded to nearest decade, e.g. 0.4 Hz will be 0.1 Hz, and 0.5 Hz will be 1 Hz)

Resolution: 1 LSD unit
Inaccuracy (relative frequency error):

$$\pm \frac{\text{LSD}}{\text{input frequency}} \pm \text{rel. trigger error}$$

± time base error

Rel. Trigger Error
For any Wave Shape:

$$\frac{\text{Measurement rate}}{\text{Signal slope (V/s)}} \times \text{peak-to-peak noise voltage}$$

For Sinewaves:

$$\frac{\text{Measurement rate}}{\text{Input frequency} \times \pi \times \text{S/N ratio}}$$

Example: for S/N ratio of 100 (40 dB) and sample rate of 1 measurement/s, the trigger error is:

$$\frac{3 \times 10^{-3}}{\text{input frequency}}$$

Input Specifications

Measuring Inputs

Input Sensitivity: (In 15 mVrms position)
LF-Input: 15 mVrms sinewave; 100 Hz...75 MHz
25 mVrms sinewave; 10 Hz...120 MHz
45 mVpp for pulses with a pulse duration of ≥7 ns
RF-Input: (PM 6668 only)
15 mVrms sinewave; 70 MHz...800 MHz
25 mVrms sinewave; 800 MHz...1 GHz
Input Attenuation:
LF-Input: x 1 to x 300 in 6 positions
RF-Input: Automatic attenuation
Trigger Level: A fixed (+, 0 or -) voltage is automatically applied to ensure proper triggering on any waveform and duty cycle.
Coupling: AC
Input Impedance:
LF-Input: 1 MΩ//≈25 pf
RF-Input: 50Ω nominal with VSWR <2 (PM 6668 only)
Max. Input Voltage Without Damage:
DC: 300V
AC: 260 Vrms at ≤440 Hz, falling to 12 Vrms at 1 MHz

Ext. Reference Input

Frequency: 10 MHz
Input Voltage Range: 0.5 Vrms...12 Vrms
Input Impedance: 2 kΩ

Time Base

(/.1. Standard Version)
Frequency: 10 MHz
Aging: ≤5 x 10^{-7}/month
Temperature Stability: (0...50°C, ref. to +23 °C): ≤1 x 10^{-5}
(/.2. TCXO Version)
Frequency: 10 MHz
Ageing: ≤1 x 10^{-7}/month
Temperature Stability: (0...50°C, ref. to +23 °C): ≤1 x 10^{-6}

General Specifications

Display: 7 digits, 11.5 mm, liquid crystal display with unit indication of Hz, kHz, MHz and LO BAT
Measurement Rate: Normal, (out): Approx. 1 measurement/s; at frequencies below 100 Hz, the measurement rate gradually slows down to one measurement per second to reduce the trigger error influence.
Power Requirements: 115/230V, ±15%, 50..60 Hz; 15 VA or built-in optional battery pack PM 9601 or by external 12V battery.
Safety: According to IEC 348 and CSA 556 B
Dimensions: 160 mm W x 77 mm H x 180 mm L (6.3 in W x 3 in H x 7.1 in L)
Weight: 1.2 kg (2.6 lb)

Environmental Conditions

Temperature:
Storage: -40°C...+70°C
Operating: 0°C...+45°C
Altitude/Barometer Pressure:
Storage: 15000m (50000 ft)/15.2 kN/m²
Operating: 5000m (15000 ft)/53.3 kN/m²
Humidity: 10%...90% RH, (26°C dew point)

Optional Accessories

PM 9601 Battery Unit

The PM 9601 is a rechargeable battery unit for mounting inside the counters. This unit contains a standard 6V, 3 Ah sealed battery of solid gel lead-acid type and is provided with charging and overcharge-protection circuitry.
Capacity (typical at 20°C):
PM 6667: 6h of continuous operation
PM 6668: 4h of continuous operation
Recharging Time (typical at 20°C):
10h to 90% of full capacity;
5h to 70% of full capacity;
Trickle charge during operation (Power on).
Weight: 0.75 kg (1.65 lb)

PM 9602 Carrying Case

Hard-shell, high-impact ABS carrying case provides protection during transportation

Included with the Instrument: Operating manual, line cord

Ordering Information

Models

January 1989 prices

PM 6667 120 MHz Counter	$520
PM 6668 1 GHz Counter	775

Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit /suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface

Input Frequency Option:	
/0-- Standard 120 MHz for PM 6667 only	N/C
/4-- Standard 1 GHz for PM 6668 only	N/C
Reference Oscillator Option:	
/-1- Standard Oscillator	N/C
/-2- TCXO	add 180
Interface Option:	
/--1 Standard front panel only, line voltage	N/C
/--3 Battery (PM 9601/01)	add 200

Options and Accessories

PM 9601/01 Battery Pack	200
PM 9602/01 Carrying Case	40
PM 9603/01 19-in Rack/Panel Mount Adapter	75
PM 9665B/01 50 kHz Low Pass Filter BNC-BNC	35

Service & Support

Warranty
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

GPIB/IEEE-488 Instrumentation Systems

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Page 380 System 21

Page 377 PM 2260

Page 374 PM 2240 TestTeam

Page 376 PM 2230 Series

Fluke and Philips meet today's increasing need for automation in test and measurement by offering one of the widest ranges of GPIB-controller instruments, industrial controllers, PC-based controllers, software tools and experienced customer support services.

The massive range of instrumentation makes it easy for the user in R&D, manufacturing and service to select the required building blocks for his application from one supplier.

Fluke and Philips anticipate the requirements of the users in R&D, manufacturing and service by offering an industrial GPIB controller for applications in manufacturing and process control demanding high speed and ease of programming. We also offer GPIB interface cards and software for PCs for applications that require flexibility and access to a wide range of software tools.

Our commitment to meet the user's requirement does not stop with products. It includes responsive customer support services which make us a uniquely qualified partner in the field of automation for test and measurement.

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Fluke & Philips GPIB/IEEE-488 Instrumentation Selection Guide

The following is a selection chart listing all the Fluke and Philips test and measurement instruments that support the GPIB/IEEE-488 bus. For more information on a particular instrument, refer to its section in the catalog.

REAL TIME OSCILLOSCOPES		Page
PM 3295A	400 MHz VHF Oscilloscope	7
PM 3296A	400 MHZ VHF Oscilloscope	7
PM 3285A	200 MHz VHF Oscilloscope	7
PM 3286A	200 MHz VHF Oscilloscope	7
PM 3065	100 MHz Oscilloscope	11
PM 3067	PM 3065 with Rackmount	11
PM 3070	100 MHz Oscilloscope with Cursors	11
PM 3072	PM 3070 with Rackmount	11
PM 3050	50 MHz Oscilloscope	11
PM 3052	PM 3050 with Rackmount	11
PM 3055	50 MHz Oscilloscope	11
PM 3057	PM 3055 with Rackmount	11

DIGITAL STORAGE OSCILLOSCOPES (DSOs)		
PM 3340	2 GHz Digitizing Oscilloscope	26
PM 3320A	250 Ms/s, 200 MHz DSO	31
PM 3365	100 Ms/s, 100 MHz DSO	43
PM 3367	PM 3365 with Rackmount	43
PM 3350	100 Ms/s, 50 MHz DSO	43
PM 3352	PM 3350 with Rackmount	43
PM 3305	35 MHz DSO	50
PM 3335	20 Ms/s, 50 MHz DSO	47
PM 3337	PM 3335 with Rackmount	47
PM 3308	Flat screen, high memory capacity DSO	37

OSCILLOSCOPE ACCESSORIES		
PM 2195	Probe Switch	58
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RECORDERS		
PM 8155	Full DIN A3 XY Plotter	464
PM 8271	XYt Universal Recorder	462
PM 8272	XYt Universal Recorder	462

LOGIC ANALYZERS		
PM 3565	Logic Analyzer	145
PM 3570	Logic Analyzer	145
PM 3655	Logic Analyzer	153

SIGNAL GENERATORS / SYNTHESIZERS		
6011A	Synthesized Signal Generator	260
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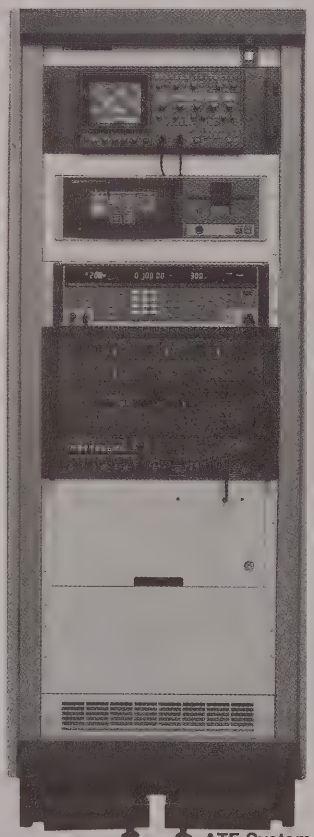
Instrumentation Systems Introduction

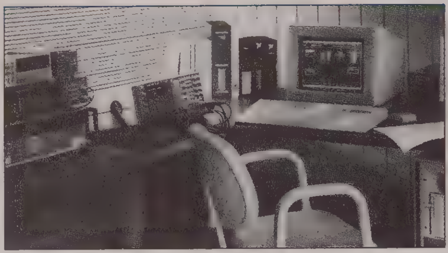


ATE System

Philips & Fluke & GPIB/IEEE-488

Philips and Fluke offer not only a wide range of sophisticated test and measurement instruments, but also controllers, software and switches for GPIB/IEEE-488* systems.

Philips' and Fluke's extensive experience in automated test and measurement has resulted in instruments ideally tailored for use in GPIB instrumentation systems. When combined with worldwide sales, support and training facilities, the user is assured of simple and timely set-up of his own GPIB system.



The GPIB (General Purpose Interface Bus) is equivalent to the IEEE-488 and IEC-625 busses as worldwide standards supported by all major instrument suppliers. Philips and Fluke participate in international standardization committees, improving existing standards to ensure GPIB instrumentation systems are easier to build.

Instrument Controller

The instrument controller is the central element in a GPIB instrumentation system. The test program covering instrument control, data processing/analysis and display will, in most cases, be developed and executed on the controller.

Philips and Fluke offer a number of software packages to ease programming of instruments, data processing/analysis and data presentation on screen for their dedicated and PC-based instrument controllers.

Dedicated Instrument Controller

The dedicated instrument controller is an industrial instrument controller specially designed to control the GPIB bus. Dedicated controllers can extract maximum performance on the bus and are typically used for large scale GPIB applications. Program execution speed and reliability are the key elements for a dedicated controller. Philips and Fluke offer the 1722A Instrument Controller for medium to large scale GPIB applications. The touch-screen, display, processing power and wide range of software and hardware make the 1722A suitable for industrial applications. For more information, see page 365.

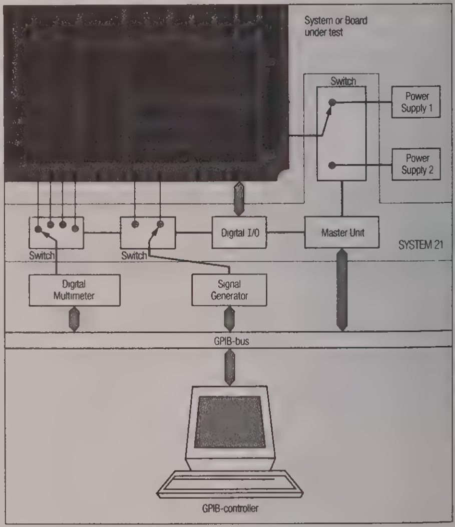
PC-based Controllers

The PC, with its excellent price/performance ratio, and wide range of software and hardware options, is now very popular as a GPIB instrument controller for small to medium-sized applications. Philips and Fluke offer GPIB interfaces for the PC/XT and AT (PM 2201, page 379) and PS/2 (PM 2202, page 379). Software is provided to ease programming, such as the PM 2240 TestTeam (page 374) and PM 2230 Series of Instrument Drivers (page 376); and the PM 2260 Oscilloscope Signal Processing Package (page 377) extends the measurement capabilities of Philips DSOs with extensive waveform analysis, display and storage functions on the PC.

Switching and I/O

Philips and Fluke offer 2 types of GPIB controlled switching and I/O systems: System 21, a modular switching and I/O system for small to medium-sized GPIB systems (page 380); and the 2205A Switch Controller/Scanner (page 392) tailored for applications in production testing, process monitoring, process automation, calibration etc.

Between them, System 21 and the 2205A cover virtually any switching applications in GPIB instrumentation systems.



The Main building blocks of a GPIB system are:

- *Instruments*
- *Switches to connect the instruments to the device under test*
- *A GPIB controller for controlling the system and processing and displaying the measured data*

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

1722A

1722A With Keyboard

1722A Instrument Controller

- Microcomputer architecture designed for system control
- Touch display operator interface
- BASIC, FORTRAN, and Assembly programming language options
- Rack mountable with removable keyboard
- 136K RAM memory expandable to over 3.0 megabytes
- High resolution graphics with graphics print capability
- RS-232-C, IEEE-488, RS-422, or 20 mA current loop and bit parallel interfaces
- High speed floating point processing implemented in firmware
- Soft-loaded operating system

The 1722A represents the evolution of a concept pioneered and introduced by Fluke in 1979 – the concept of using a touchscreen as the primary interface between an operator and a high-performance instrument controller. Few things could be more user-friendly. And it allowed the keyboard to be treated as a programming tool, usually unplugged and removed from an operating instrumentation system. Rack mounting was simple.

Fluke's first instrument controller was the 1720A. The 1722A has improved capabilities. But, because we are committed to maintaining the highest possible level of software compatibility consistent with evolutionary improvements, the 1722A runs programs that were developed for even the first 1720As delivered. As we continue to develop microcomputer products at Fluke, the software investments made by our customers remain a foremost design consideration.*

High Performance Microcomputer

The 1722A is a microcomputer designed for control of automated instrument systems in the laboratory, the plant, or the factory and for information management systems.

The 1722A is an entirely new design internally. The high speed 16-bit microprocessor uses a 24 MHz clock to achieve an instruction cycle rate of 6 MHz. High-speed floating point arithmetic processing is implemented through extensions o the microprocessor instruction set. A separate display processor, with high speed vector generator and graphics memory work space, functions as an independent graphics display terminal for the central processor.

When powered on, the 1722A looks to its internal floppy disk (or to optional non-volatile RAM) for operating software. Updating to newer software is a simple matter of inserting a disk and restarting. You are not tied to permanently-installed ROMs. Yet the 1722A is easily set up to automatically start running your application. After loading operating software, it looks for a start-up command file. The file is treated as keyboard inputs, instructing the controller to perform any task sequence. If software is stored in optional non-volatile RAM memory, you never need to bring a disk near it.

RAM memory in the 1722A can be partially allocated as a file-structured electronic disk, for high speed task overlays and large, fast-access virtual data arrays. Software development tools make the task of writing programs more efficient through such features as wildcard file identification, utility command files, and recall of previously typed commands.

The 1722A includes five slots for additional memory and interface options. The standard 136K RAM memory is internally expandable to over 3.0 megabytes. The 400K-byte internal floppy disk drive capacity can be expanded through the 1760A or 1761A Disk Drives to 2 megabytes of on-line floppy disk file storage. The 1765B Series of Winchester disk drives provides 20M bytes of file storage, in two models. Non-volatile RAM options can be installed for rugged, permanent file storage, especially suited for harsh environments. Up to 2.5M bytes of non-volatile memory, may be installed.

Touchscreen Display System

With its touchscreen display, the 1722A is particularly well suited for applications where semi-skilled personnel need to operate complex systems performing sophisticated tasks. The friendly graphics display takes the place of the often-intimidating keyboard, yet offers access to the software that keeps your system running. An operator is prompted one step at a time for information or decisions through informational displays, and responds by simply touching the screen. The predictability of procedures allows true trend analysis to be performed, pinpointing common failure modes or process impediments. Systems based on this concept are easily updated for new tasks. The cost and downtime of installing new switch or key labels is eliminated.

Fluke's experience producing the touchscreens goes back to 1979. It has proven to be a rugged, reliable component.

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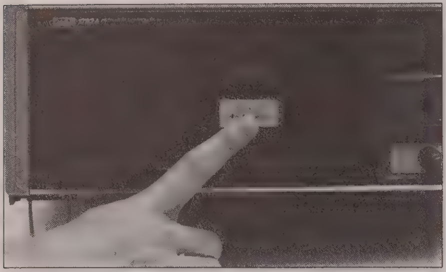
* *The 1722A has been incorporated into a number of Fluke calibration systems. See pages 212 through 226.*

1722A



Touchscreen interactive display

Characters Plus Graphics

The graphics display capability of the 1722A is independent of its character display, and of the 1722A central processor. With its own display processor, high speed vector generation hardware, and 64K graphics display memory, the 1722A is a sophisticated tool in the hands of the creative system designer. The 64K display workspace is over three times the size of the 640 by 224 pixel display window: 2048 pixels wide by 256 pixels high. You can use it to display data in strip chart form, and move the display across the window by touch commands. You can also use it to prepare up to three independent data screens available for instant display. Once the graphics display is generated, a hard copy of the graphics plane can be printed under program control.

The 1722A character display is an independent function that can overlay graphics data displays for labels, or be used alone for test and for programming. Because the graphics and character displays can be independently enabled, screens can be prepared "off-line" and displayed when ready. Numerous ANSI-compatible character attributes are available to add emphasis to portions of displays. Attributes such as inverse or underline can be pre-defined for display fields, or made a part of characters as they are sent to the screen.

The 1722A includes an industry standard composite video output that will display what ever is on the 1722A screen on a video monitor. This can be useful for training presentations as well as for system requirements that include a remotely mounted display.

Interfacing

The 1722A includes an IEEE-488 bus interface port and an RS-232-C serial port. The IEEE-488 interface can control up to 14 instruments at transfer rates of up to 30K bytes per second. Powerful IEEE-488 commands are supported as a part of each 1722A programming language. The 1722A can be set up to function as a system controller or as an addressable device in a multiple-controller system. In either configuration, the 1722A can pass control to another controller and take it back when offered. As system controller, the 1722A starts up as controller-in-charge and can use IFC (Interface Clear) to reset all bus devices.

Three of the five expansion slots are available for additional interfaces:

Option 17XXA-008 adds an additional IEEE-488 interface and an additional RS-232-C serial data port. The 1722A can accomodate up to four IEEE-488 ports.

Option 17XXA-009 is a reconfigurable, dual serial port with its own buffer memory. It is supplied configured for RS-232-C with full modem compatibility. Each port can be easily reconfigured for a 20 milliamp current loop, or for RS-422 balanced lines. Up to three -009s may be installed for a total system of seven serial ports.

Option 17XXA-002 (Parallel Interface) gives you two independent 16-bit parallel I/O ports that can function as independent lines, 8-bit bytes, or 16 or 32-bit words. Line protocol is available (but not required), and the sense of the data can be reconfigured to either High true or Low true. A maximum of three modules may be installed for a total of six 16-bit ports.

Options & Peripherals

RAM Memory Expansion Modules (-006, -007, -016, -017)

Internal program and data space may be expanded to over 3M bytes with RAM expansion options. Memory may be added in the following increments:

17XXA-006 256K bytes
17XXA-007 512K bytes
17XXA-016 1M bytes
17XXA-017 2M bytes

Application programs can assign any part of this memory to function as an "Electronic Disk." Programs and data may be loaded to this E-Disk, allowing faster transfer rates and no disk wear.

Non-volatile RAM Options (-018, -019, -020)

These options provide either 256K bytes (-018) or 512K bytes (-019) or 1M bytes (-020) of file-structured, non-volatile RAM memory. Transfer rates are comparable to RAM -- over 1M bytes per second. Up to 5M bytes non-volatile RAM may be installed in the 1722A.

Non-volatile RAM is solid-state medium which is immune to pollution and vibration, making it ideal for harsh environments where floppy disk operation is not practical. Non-volatile RAM is battery backed up for up to five years to retain its file contents through a power loss. Since non-volatile RAM has a much greater tolerance to temperature extremes than other media, the 1722A can operate from 0°C to 40°C when non-volatile RAM is the primary file storage medium. Non-volatile RAM provides a write protection switch to protect its file contents.

Internal Winchester Disk Drive

John Fluke Mfg. will be introducing an internal winchester disk drive for the 1722A in April 1989. For further information please contact your local Fluke Sales Eingineer or Representative.

External Floppy Disk Drive Systems (1760A and 1761A)

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage. The 1760A and 1761A use double-density dual-head disk drives. The full on-line capacity is 400K bytes for the 1760A, and 800K bytes for the 1761A, including a file directory for each floppy disk. They interface to the 1722A via the IEEE-488 port. Both systems are rack mountable and easy to install and use. Transfer rate is 22K bytes per second. Up to two 1761As can be accommodated, for a total of 2M bytes of on-line floppy disk file space.

External Winchester Disk Drive

The 1765B Series of Winchester disk drives provides high-capacity hard disk file storage for the 1722A Instrument Controller:

1765B/20 20M byte Winchester Disk Drive
1765B/20M Multi-User 20M byte Winchester Disk Drive

Both models provide for easy connection to the 1722A Instrument Controller through a standard IEEE-488 interface, and are rack-mountable, using the optional rack-mount kit. More information is available in the following "Disk Drive" section.

Floating Point Math Coprocessor

John Fluke Mfg. will be introducing a floating point math coprocessor for the 1722A in April 1989. For further information please contact your local Fluke Sales Engineer or Representative.

Software

For information regarding 1722A Software, see the following "Software" section.

Module-Level Diagnostics

The 1722A is a modular design with diagnostic software that allows semi-skilled operators to identify failures to the module level. Spare-module kits are available for the most time-critical applications. Fluke also maintains an inventory of 1722A modules that may be shipped within hours in most cases, and which can be exchanged for a defective module for a nominal charge. Contact your Fluke Technical Service Center for more information.

Manuals That Make the Task Easy

Experience will tell you that the major investment in an automated instrument system is not in the hardware, but in system integration and the development of application software to run it. The quality of documentation is a key consideration. You will find that 1722A manuals are among the most readable, consistent, and sensible software documentation available anywhere. Ask your Fluke Sales Engineer or Representative to let you evaluate the 1722A through its manuals. You will be pleasantly surprised.

OEM Sales 1722A in Your Products

The 1722A is used as a component part of many products manufactured by companies other than Fluke. Custom packaging and matching paint colors are routinely negotiated. Fluke offers the discounts, policies, and worldwide support to make it work, too. If you are designing a product that would be more competitive with a touchscreen and a high performance microcomputer system, call your Fluke Sales Engineer or Representative for more information.

Specifications

Temperature: 10°C to 40°C with floppy disk, operating; 0°C to 40°C without floppy disk, operating. 10°C to 52°C with floppy disk, non-operating; -20°C to 60°C without floppy disk, non-operating

Relative Humidity: 20% to 80% non-condensing, operating; 8% to 90% non-condensing, with floppy disk, non-operating or 5% to 95%, non-condensing, without floppy disk, non-operating

EMI and RFI Emissions: Tested to FCC Part 15, Subpart J, Class B; VDE 0871, Class B; CISPR 11-1975

Power: 90V to 132V ac or 180V to 264V ac, 47 Hz to 440 Hz. 175W maximum

Size: 13 cm H x 43 cm W x 55 cm L (5.25 in x 17 in x 21.5 in) plus feet

Weight: 14.5 kg (34 lb). Keyboard 1.4 kg (3 lb)

Included: Y1700 Keyboard, power cord, BASIC system disk, diagnostic disk, "Getting Started" manual and disk, System Guide manual, Operator's manual, BASIC Programming Manual, and a pad of 50 display worksheets

Ordering Information

Model

January 1989 Prices

1722A Instrument Controller	$6990
1722A-1 Instrument Controller w/o Keyboard	6790

Options (for 1722A & 1722A-01)*

-002 Dual 16 Bit Parallel Interface	990
-006 256K-Byte RAM Expansion	1000
-007 512K-Byte RAM Expansion	1400
-008 IEEE-488/RS-232 Interface	850
-009 Dual Serial Interface	990
-016 1M-Byte RAM Memory Expansion	1800
-017 2M-Byte RAM Memory Expansion	3200
-018 256K-Byte Non-Volatile RAM	1700
-019 512K-Byte Non-Volatile RAM	2700
-020 1M - Byte Non-Volatile Ram	3700

Language Systems (See page 368)

-200U System S/ W Update	150
-201 Assembly Language Development System	1495
-202 FORTRAN Development System	1495
-203 Compiled BASIC Development System	490
-205 Extended BASIC Development System	490
-912 Non-ANSI C Development System	1995
-913 Non-ANSI C Compiler	1495

Software Options (Also see page 368)

-900 Software Binder	30
-901 Gabby	195
-902 Touchscreen Toolbox	295
-903 Compiled MenuBASIC	295
-905 Extended MenuBASIC	295
-907 Transport±PC	450
S1703 Compiled MenuBASIC Development Package	1900
S1705 Extended MenuBASIC Development Package	1900

Peripherals

1020 Touch Control Screen (includes a desk-top enclosure)	1820
1021 Touch Control Screen	1695
1760A 400K Byte Disk Drive	1950
1761A 800K Byte Dual Disk Drive	2950
1765B/20 20M Byte Winchester Disk Drive	3295
1765B/20M Multi-User 20M Byte Winchester Disk Drive	on req
1780A InfoTouch® Display	2150

Accessories (Also see page 485)

Y1700 Programmer's Keyboard	395
Y1702 2m RS-232-C Null Modem Cable	125
Y1703 4m RS-232-C Null Modem Cable	150
Y1704 Circuit Board Extender	200
Y1705 0.3m RS-232-C Null Modem Cable	75
Y1706 Double-Sided Blank Disks (package of 10)	60
Y1707 2m RS-232-C Interface Cable	125
Y1708 10m RS-232-C Interface Cable	150
Y1709 2m Printer Cable	125
Y1790 Rack Mount Kit w/24" Slides	195
Y1795 Carrying Handle for portability	48
Y8021 1m Interface Cable for IEEE-488 bus	130
Y8022 2m Interface Cable for IEEE-488 bus	145
Y8023 4m Interface Cable for IEEE-488 bus	155

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1722A Repair	221

1700 Series Software

The power of any computer system lies in the software that is supported with the system. The 1722A Instrument Controller and 1752A Data Acquisition System support a variety of soft ware development systems, utilities and applications packages. Each package is designed to help the programmer develop software to fit the system to his particular application. Fluke also offers training and consulting services to help get your system up and running in the shortest possible time.

System Software

- File Utility Program
- SET
- Alias File
- Command Files
- TCOPY
- EDIT
- SHELL

Fluke's FDOS operating system combines the best features of both benchtop computers and minicomputers. Like a benchtop unit, the user can power-up the system and immediately begin programming in BASIC. No further knowledge of the operating system is required. For the advanced programmer, powerful utilities allow the user to perform complex functions with a minimum of keystrokes. Features include:

File Utility Program — Simplifies management of file structured devices such as the floppy disk, or bubble memory. Its concise, simple commands allow the user to transfer the con tents of files or whole disks with a single command. Other features include wildcards, interactive commands, and file protection.

SET — Allows software set-up of serial port communications parameters, including baud rate, timeouts, and XON/XOFF handshaking.

Alias File — Allows the user to define his own commands for the system.

Command Files — Allows the user to define command sequences for the system. Flexible features allow the user to develop interactive sequences which can interface with the operator through either the keyboard or the touchscreen. Command files may also be used to automate the controller's start-up sequence.

TCOPY — The touch copy utility allows the user to perform file management through the touchscreen. It allows copying of files by name, date of creation, etc.

EDIT — The system editor is a powerful screen editor, with capabilities for searching, replac ing, and cut-and-paste.

SHELL — The user may set the default console program with the SET SHELL command. This allows the programmer to design a system where his application program is the only software that the operator can see.

Other utilities allow the user to configure the operating system, check compatibility between various versions of software, and set the time and date through the touchscreen.

Language Systems

- Interpreted BASIC
- Compiled BASIC
- Extended BASIC
- FlexSys Test Software (ATLAS)
- Assembly Language
- Non-ANSI C
- FORTRAN

BASIC

The 1700 Series supports three BASIC packages. Compiled BASIC and Extended BASIC are available as options. Each package provides the programmer with the development tools necessary to take on the task of developing industrial control systems.

Compiled BASIC

The 17XXA-203 Compiled BASIC Option provides greater flexibility and speed while maintaining the ability to compile Fluke Interpreted BASIC. Programs can be run three to five times faster with Compiled BASIC than with Fluke Interpreted BASIC, while using less memory. Compiled BASIC includes the capability of linking subroutines in FORTRAN or Assembly Language.

Compiled BASIC permits large multiple-line statements, and long descriptive variable names. It also permits labels to be used in place of line numbers for branch targets while leaving the use of line numbers optional. Compiled BASIC subroutines exchange parameters, and use local variables and common variables for true modularity. This freedom of format allows BASIC programs to be written in a readable, structured form. Multiple-line statements can be especially useful, for example, when a program requires many lines following an IF state ment. Key features include:

- Program execution 3 to 5 times faster
- True subroutines with local variables
- Use of program overlays for large programs
- Three dimensional arrays
- Alphanumeric labels for lines and/or statements
- Long variable names
- Continuation lines — up to 200 lines per line number
- Powerful screen editor

Extended BASIC

The 17XXA-205 Extended BASIC Option provides a compiler that allows the 1722A programmer to easily develop large BASIC programs without having to use a complex overlay structure that can be required when using Fluke Compiled BASIC. (Program space can be over two megabytes.) The statements and syntax are the same as those found in our Compiled BASIC. Key features include all those mentioned for Compiled BASIC except execution speed is only twice as fast as Fluke Interpreted BASIC, while eliminating complex program overlays.

Comparison of Fluke BASIC Offerings

Feature	Interp'd BASIC	Compiled BASIC	Extended BASIC
Program Size	28K bytes	35K bytes	>2M bytes
Execution Speed Ratio (appx)	1	3-5	2-3
Program Expansion Method	Chaining	Overlays	None req
Immediate Mode Commands	Yes	No	No
3-D Arrays	No	Yes	Yes
Continuation Lines	No	Yes	Yes
Long Variable/ Statement Names	No	Yes	Yes
True Subroutines	No	Yes	Yes
Program Libraries	No	Yes	Yes
Option To Omit Numbers	No	Yes	Yes
Input Line Statement Capacity	80	510	510
Import/Export Statements (Global Variables)	No	No	Yes
Step Mode Debugging	Yes	No	No

FORTRAN

The Fluke 17XXA-202 offers a complete system for development of FORTRAN programs or subroutines with performance rivaling many minicomputers. Fluke FORTRAN makes it easy to use the features of the 1700 Series. Libraries provide routines for numeric and text manipulation, touchscreen and graphics support, and communications, including GPIB/IEEE-488*. Fluke FORTRAN can also interact with the operating system to provide functions such as file management and interaction with the system's command line interpreter.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Typical Statement Execution Times

	BASIC	Compiled BASIC	FORTRAN
Math Functions Execution Time, msec*			
= (Assignment)	0.460	0.152	0.004
+	0.474	0.353	0.237
—	0.477	0.353	0.224
*	0.506	0.383	0.209
/	0.682	0.554	0.221
≜	4.821	4.652	2.902
SIN	2.301	2.052	1.332
COS	2.431	2.202	1.242
TAN	4.771	4.512	2.802
ATN	3.361	3.122	1.422
SQR	1.611	1.382	0.842
LOG	2.351	2.112	1.462
LN	2.461	2.222	1.542
EXP	2.411	2.172	1.512
Control Statements			
FOR Loop (integer counter)	0.189	0.076	0.004
IF-THEN	0.622	0.121	0.110
GOSUB/RETURN	0.254	0.142	0.036

Data may vary depending on application

Assembler

The 17XXA-201 allows the programmer to develop high speed or specialized routines in assembly language. The package includes a structured preprocessor which allows the use of high level constructs for program flow control. Using Macrostore*, double- and single- precision floating point arithmetic instructions become part of the language, simplifying code development. Also provided is the Hex Debugging Tool (HDT), with disassembly capability to speed program development.

C

The 17XXA Non-ANSI C Development System supports features such as user defined data structures, full complement of math functions, bit fields, string manipulation and Whitesmith I/O. For real-time and instrument control applications, the system supports a full complement of interrupt processing structures, IEEE-488 I/O commands, and a complete interface to the FDOS operating system.

This package requires the 17XXA-201 Assembly Language Development System. Due to this, the package is available two ways; as the 17XXA-913 Non-ANSI C Compiler or as the 17XXA-912 C Development System, which includes both the 17XXA Non-ANSI C Compiler and the 17XXA Assembly Language Development System.

FlexSys Test Software (ATLAS)

To speed development and reduce software maintenance costs of test systems, the ATLAS language is available for the 1722A. More information is available in the following FlexSys section.

Linkers and Library Management

Linking and Library Management utilities are provided standard with the following software packages:

- 17XXA-201 Assembly Language Development System
- 17XXA-202 FORTRAN Development System
- 17XXA-203 Compiled BASIC Development System
- 17XXA-205 Extended BASIC Development System

Fluke's Linking programs allow the user to modularize his program, by compiling routines one at a time, and then linking the final software package. This simplifies the management of projects requiring multiple software engineers. Support for overlays is offered through the Linkage Editor. The Library Manager may be used to build libraries of user defined routines.

**Macrostore is a trademark of Texas Instruments Incorporated.*

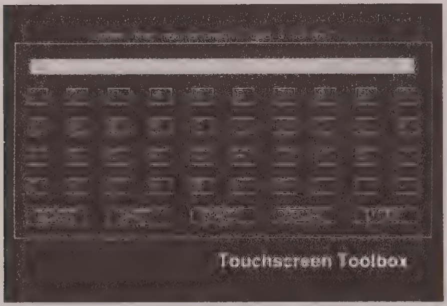
Selection Guide — Language Systems

Language	Item Number	Program Space	Data Space	Touch-screen Support	IEEE-488 Support	Comments	Compilation speed (stmts/min)	Real-Time Interrupts	Hardware
BASIC									
Interpreted	n/a	28K bytes [1]	to 3M bytes	Std	Complete		n/a	Yes	
Compiled	17XXA-203	35K bytes [1]	to 3M bytes	Std & Adv [3]	Complete	Structured BASIC	~2400	Yes	17XXA-016 1M byte RAM [2]
Extended	17XXA-205	to 3M bytes	to 3M bytes	Std & Adv [3]	Complete	Structured BASIC	~2400	Yes	17XXA-016 1M byte RAM [2]
FORTRAN	17XXA-203	64K bytes [1]	to 3M bytes	Std	Complete	FORTRAN IV	~300	No	17XXA-016 1M byte RAM [2]
Assembler	17XXA-201	64K bytes	64K bytes	Std	Std	Hex Debugging Tool Provided	~4500	Yes	
Non-ANSI C	17XXA-912	64K bytes [1]	to 3M bytes	Std	Complete	Whitesmith C I/O	~1000	Yes	17XXA-016 1M byte RAM [2]

[1] *Can be increased using overlays or chaining*

[2] *Recommended hardware*

[3] *Advanced Support available through Touchscreen*



Fluke Application Software

- Gabby
- Touchscreen Toolbox
- MenuBASIC
- TransPort—>PC

Gabby

The Gabby Terminal Emulation Program (17XXA-901) is a communications program which provides a simple method of transferring 1700 Series files to and from almost any host computer. Gabby emulates a terminal attached to the host computer and also allows uploading and downloading of files between the 1700 Series and the host computer. With Gabby, all commands are accessed through the touchscreen, relieving the user from the task of learning cryptic command sequences. Gabby includes three appendices showing step by step instructions for use with the UNIX*, RSTS*,and VAX/VMS*.

Touchscreen Toolbox

Fluke's expertise in developing human interfaces using the touchscreen is made available to the programmer through the 17XXA-902 Touchscreen Toolbox package. The package cuts the time required to develop a menu based system, while ensuring that the resulting menus will be simple for the operator to use. The package also includes calculator-style and alphanumeric keypads to simplify the tasks of entering data such as process control parameters, operator identification, or serial numbers.

MenuBASIC

MenuBASIC is a tool designed to simplify the task of developing programs for the 1700 Series. It provides access to a powerful BASIC language, complete with advanced structures such as CASE statements and true subroutines, and features designed to simplify systems development such as full IEEE-488 support and multilevel interrupt structure. MenuBASIC also features a powerful editor which can search, search and replace, and merge programs interactively.

MenuBASIC makes these and other features easy to use by allowing the programmer to select actions from a menu presented on the screen. Memorizing the commands is not required, since they are displayed on the screen as part of the menu. This makes learning how to use MenuBASIC a simple task, as well as allowing single key commands to perform functions which require long command strings on most systems.

MenuBASIC is also available as Development Packages which provide everything you need to meet MenuBASIC software and memory requirements. Both include MenuBASIC software, a manual, a 512K-Byte Memory Expansion Module, and a Compiled or Extended BASIC language package.

MenuBASIC features include:

- **BASIC Language:**
  - Full IEEE-488 Support
  - Multiple-Level Interrupt Structure
  - Virtual Arrays
  - Line Numbers Optional
  - True Subroutines with Local Variables
  - Long Variable Names
  - Advanced Control Structures (IF-THEN, WHILE, CASE, etc.)
- **Program Development:**
  - Interactive Environment
  - Advance Editor with Search Replace Cut and Paste
  - Interactive File Merging
  - Simplified, Single Key Commands
- **System:**
  - Ability to link other MenuBASIC, FORTRAN or Assembly Modules
  - Full File Control (Copy, Delete, etc.)
  - Complete Serial Port Control (Baud Rate, Parity, etc.)

MenuBASIC Options

17XXA-903	Compiled MenuBASIC:Compiled MenuBASIC software & manual.
17XXA-905	Extended MenuBASIC:Extended MenuBASIC software & manual.
S1703	Compiled MenuBASIC Development Package: Software and manual for Compiled MenuBASIC (17XXA-903); Compiled BASIC Language (17XXA-203) and 512K-byte Memory Expansion Module (17XXA-007).
S1705	Extended MenuBASIC Development Package: Software and manual for Extended MenuBASIC (17XXA-905); Extended BASIC Language (17XXA-205) and 512K-byte Memory Expansion Module (17XXA-007).

TransPort—>PC

TransPort—>PC is a communications software program for the 1700 Series. TransPort—>PC provides a simple method for translating any ASCII text file from a disk configured by the Fluke Floppy Disk Operating System (FDOS) into a format acceptable to the IBM PC, IBM XT, or other highly-compatible microcomputer.

TransPort—>PC allows you to combine the computing and controlling power of the versatile, high-speed 1722A and 1752A with the flexibility and resources of data manipulation programs available for the personal computer.

The export utility provided with TransPort—>PC allows you to transfer numeric virtual arrays from the 1700 Series to the personal computer. Programs such as Lotus 1-2-3® can be used to display the file in spreadsheet form or as a bar, stacked-bar, pie, line or XY graph.

Selection Guide – Application Software

Package Name	Item Number	Features	Required Hardware	Required Software
Gabby	17XXA-901	• Communication between 1722A/1752A and Host Computer • Terminal Emulation • File Upload/Download • SImple Touchscreen Menu Interface • Documentation for use with: UNIX 4.1, 4.2 BSD RSTS/RSX-11 VMS	1722A with graphics print capability (all units shipped after February 1,1985) or all 1752As	Cable to Host Computer
Touchscreen Toolbox	17XXA-902	• Simplifies development of menu-based systems • Provides numeric and alphanumeric keypads • Cuts programming time from days to minutes • Provides ergonomic menu design • Frees graphics plane for other uses	1722A/1752A	17XXA-203 Compilied BASIC or 17XX-205 Extended BASIC
MenuBASIC	17XXA-903 or S1703 [3] 17XXA-905 or S1705 [3]	• Supports Compiled BASIC (see Selection Guide for Language Systems) • Supports Extended BASIC (see Selection Guide for Language Systems) • Interactive Program Development Environment • Integrated Menu Based System • Advanced Editor • Automatic, Fast Compilation and Linking • File/Memory Management	1722A/1752A 17XX-007 512 byte RAM Expansion [1] 17XXA-016 1M byte RAM Expansion [2]	17XX-203 Compiled BASIC or 17XXA-205 Extended BASIC
TransPort-->PC	17XXA-907	• Allows transfers of data disks from 1722A/1752A to IBM-PC, IBM-XT or highly-compatible microcomputer • Transfer of numerical 1722A/1752A data files into LOTUS 1-2-3 or dBase III formats	1722A/1752A IBM-PC, PC/XT or highly-compatible microcomputer with 2 floppy drives, or 1 floppy and Winchester, 256K bytes RAM	

[1] Required hardware
[2] Recommended hardware
[3] S1703 and S1705 Packages include 17XXA-007 512K byte RAM Expansion and all required software

**UNIX is a trademark of AT & T Bell Laboratories*
***RSTS, RSX-11, and VMS are trademarks of Digital Equipment Corporation*

IBM is a trademark of International Business Machines, Inc.
LOTUS and 1-2-3 are trademarks of Lotus Development Corporation
dBase III is a trademark of Ashton-Tate Corporation

Ordering Information

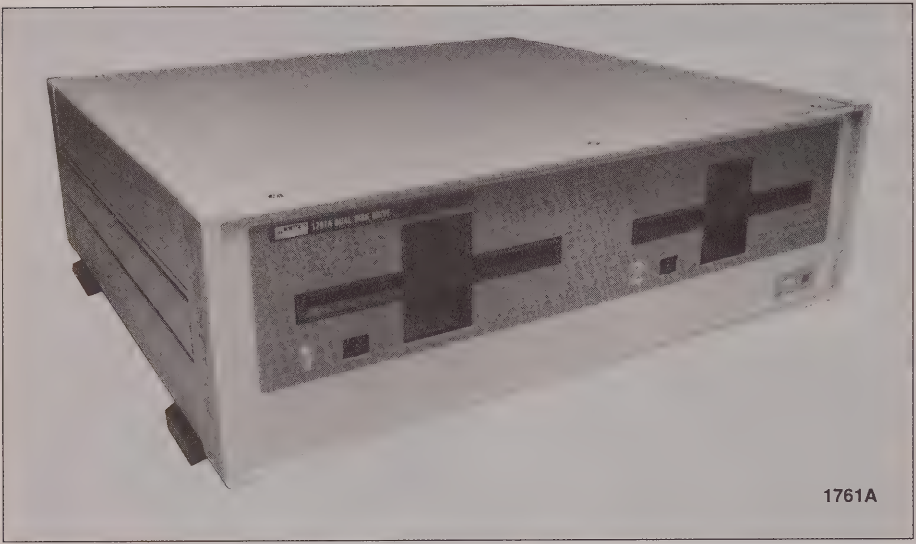
Language Systems

17XXA-201 Assembly Language Development System	$1495
17XXA-202 FORTRAN Development System	1495
17XXA-203 Compiled BASIC Development System	490
17XXA-205 Extended BASIC Development System	490
17XXA-912 Non-ANSI C Development System	1995
17XXA-913 Non-ANSI C Compiler	1495

Application Software

17XXA-900 Binder	$30
17XXA-901 Gabby	195
17XXA-902 Touchscreen Toolbox	295
17XXA-903 Compiled MenuBASIC	295
17XXA-905 Extended MenuBASIC	295
17XXA-907 TransPort—>PC	450
S1703 Compiled MenuBASIC Development Package	1900
S1705 Extended MenuBASIC Development Package	1900

1760A & 1761A



1761A

1761A & 1761A Disk Drive Systems

- Compatible with IEEE-488 bus controllers
- Software supported for Fluke 1722A and 1752A Instrument Controllers
- 400K bytes of on-line capacity (1760A)
- 800K bytes of on-line capacity (1761A)
- Low EMI and RFI emissions, designed for lab environments
- Rack mountable
- Automatic self-test
- Double-density, double-sided format

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage for IEEE-488 bus systems. Rack mountable and supported with software for 1700 Series Instrument Controllers, you will find them easy to install and use. Installation is a matter of mounting and connecting the IEEE-488 bus cable. When used with a Fluke 1722A Instrument Controller or the 1752A Data Acquisition System, you will not need to be concerned with events and protocol on the IEEE-488 bus: available software for the Controllers allows either disk drive to be treated by application programs as if it were simply an additional drive installed in the controller.

Support software available for the 1722A Instrument Controller and 1752A Data Acquisition System is provided with the controller.

Specifications

Technical Specifications

Access Time: 505 ms, average

Transfer Rate: 50K bytes per second, burst; 12K bytes per second, average, with typical sector interleave

On-Line Capacity: 400K bytes with 1760A, 800K bytes with 1761A

Track Density: 48 tracks per inch

Speed: 300 revolutions per minute

Recording Format: 512 bytes per sector, 10 sectors per track, and 40 tracks per side (80 total). Double-density encoding

Disk: Fluke-qualified industry-standard 5.25 inch, certified double-density, 40 tracks, both sides

Disk Life: More than 3 x 106 revolutions with head contact, per track

Error Rates: 1 bit per 109, recoverable; 1 bit per 1012, non-recoverable

General Specifications

Signal Emissions: FCC Part 15, Subpart J, Class A; VDE 0871, Class B; CISPR 11-1975

Temperature: 10°C to 40°C, operating; -10°C to 60°C, non-operating

Relative Humidity: 20% to 90% from 10°C to 30°C, 20% to 80% from 30°C to 40°C, operating; 5% to 95%, non-operating

Power: 90V to 110V ac, 108V to 132V ac, 198V to 242V ac, or 216V to 264V ac, selectable, 47 to 63 Hz. 55W for 1760A, operating; 70W for 1761A, operating

Size: 13.3 cm H x 43.2 cm W x 39.6 cm D (5.25 in x 17.0 in x 15.6 in), both models

Weight: 1760A is 7.7 kg (17 lb), 1761A is 9.1 kg (20 lb)

Ordering Information

Models

January 1989 prices

1760A Disk Drive System	$1950
1761A Dual Disk Drive System	2950

Accessories (Also see page 485)

Y1706 Double-Sided Blank Disks (pkg. of 10)	60
Y1790 Rack Mount Kit w/24" Slides	195
Y1794 Rack Mount Kit w/18" Slides	175
Y8021 1m IEEE-488 Cable	130
Y8022 2m IEEE-488 Cable	145
Y8023 4m IEEE-488 Cable	155

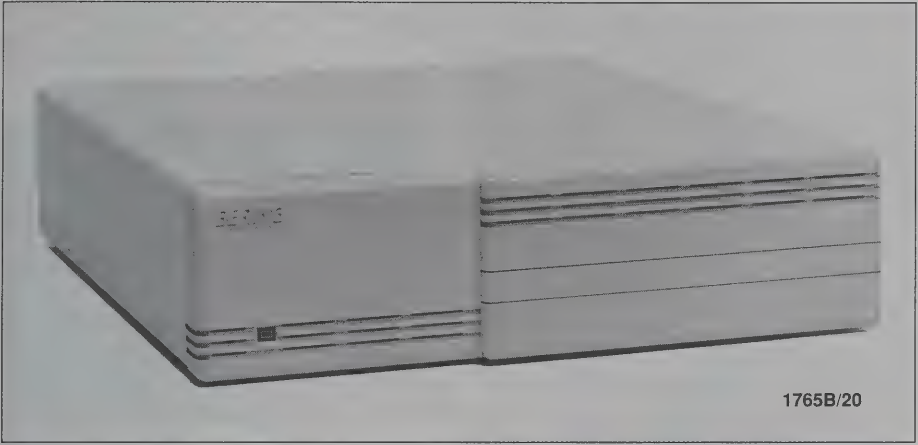
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1760A Repair (w/calibration)	132
SC1-1761A Repair (w/calibration)	144


1765B/20

Winchester Disk Drive Systems

- GPIB/IEEE-488 commands transparent to user
- Average data transfer rate over IEEE-488 bus: 30K bytes/sec
- Complete self-test capability
- Rack mountable

The 1765B Series of Winchester disk drives provides high-capacity hard disk file storage for the Fluke 1722A Instrument Controller and 1752A Data Acquisition System. Both models provide for easy connection to the Controller or Data Acquisition System through a standard IEEE-488 interface. Both models are also rack-mountable. The 1765B Series is supplied to Fluke by a major disk drive subsystem manufacturer.

When used with a Fluke 1722A or 1752A, accommodating the 1765B Series is a snap. After connecting the 1765B to an IEEE-488 port of the controller or data acquisition system, you will have 20 megabytes of on-line storage.

When used with a Fluke 1722A Instrument Controller or 1752A Data Acquisition System, you will not need to be concerned with commands to the drive over the IEEE-488 bus. The system software created by the FDOS system generation program allows the Winchester drive to be treated by applications programs as if it were simply an additional drive installed within the mainframe.

Model Number 1765B/	Capacity M Bytes	No. of Users	Storage/ User M Bytes	Max Dis. to Contr.
20	20	1	20	14m
20M	20	3	5 + 5 Shared	20m*

** At least one 1722A or 1752A connected to the 1765B/20M must be located within 4m of the drive.*

1765B/20 20M-Byte Winchester Disk Drive

The Fluke model 1765B/20 is divided into eight logical devices of 2.5M bytes each. These logical devices are addressed as WD0: through WD7:.

1765B/20M Multi-User 20M-Byte Winchester Disk Drive

The 1765B/20M is a multi-user version of the 1765B/20. It has the capability of supporting up to three 1722As or 1752As. Each user has access to 5M bytes of Winchester disk storage. The other 5M is shared among all of the users connected to the system. The shared space can be used to transfer files between controllers, or to store files which are needed by more than one user connected to the system. 1722As or 1752As connected to the 1765B/20M can be located up to 20m away from the drive (one controller or data acquisition system must be located within 4m of the 1765B/20M).

Specifications

Maximum Sustained Transfer Rate: 30K bytes/second
On-line Capacity: 20M bytes divided into eight logical devices of 2.5M bytes each
Track Density: 588 tracks per inch
Rotational Speed: 3600 rpm
Recording Format: 256 bytes per sector, 34 sectors per track
Error Rates: Head read errors — 1 per 1012 reads
Temperature: 10°C to 40°C, operating; 40°C to 60°C, non-operating
Humidity: 20% to 80%, operating; 5% to 95%, non-operating
Shock: 10.0g
Vibration: 0.5g
Elevation: 0 to 4572m (0 to 15,000 ft), operating; -304 to 15,240m (-1000 to 50,000 ft), non-operating
Power: Selectable: 90 to 132V ac, 198 to 264V ac. 47 Hz-63 Hz. 1.1 amp @ 120V ac, 0.6 amp @ 240V ac
Weight: 10.58 kg (23.5 lb)
Size: 107mm H x 394mm W x 446mm D (4.2 in H x 115.5 in W x 115.5 in D)

Ordering Information

Models

January 1989 prices

1765B/20 20M-Byte Winchester Disk Drive	$3295
1765B/20M 20M Multi-User Winchester Disk Drive	on req

Accessories (Also see page 485)

Y1765B Rack Mount Kit	550
Y1765M 16m IEEE-488 Cable*	on req

**This IEEE cable only works with the 1765B/20M*

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1765B Repair (w/calibration)	265

PM 2240

NEW

PM 2240 TestTeam

- Fast, simple program generation for GPIB/IEEE-488 instrumentation systems
- Easy to use, menu-oriented operation with pull-down menus and pop-up windows
- Extensive instrument library allows GPIB/IEEE-488 programming by selecting parameters on instrument panels
- Built-in graphics and analysis functions for simple presentation of measurement data
- Powerful debugging tools for error-free programs
- Available for IBM PC's or PS/2

PM 2240 TestTeam provides GPIB/IEEE-488* programmers with a complete, easy to use environment for the generation, interactive use and execution of application programs in QuickBASIC™ or C. It combines Fluke and Philips instrument libraries with the National Instruments Labwindows programming environment.

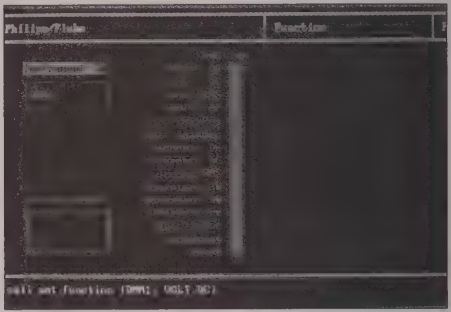
Fast, Simple Program Generation

The TestTeam programming environment greatly reduces programming time with its simple and powerful editor and large number of standard functions and libraries. These facilities are readily available via pull-down menus and pop-up windows. A programmer can create a program in either QuickBASIC or C using the editor, and insert calls to graphics, analysis and instrument control functions by filling in function panels. An online context-sensitive help facility guides the novice through parameter entry in these panels.

Complete Instrument Control

In the instrument library, support is provided for numerous Philips and Fluke instruments in the form of specific instrument drivers. A programmer controls an instrument by simply entering parameters in a function panel. The generated function call can be inserted in the application program, at the current location of the cursor, or executed immediately. The generated function call is clear and self-documenting, considerably reducing the time to interpret previously written programs. Instrument drivers include thorough error checking ensuring reliable measurement results. With so many ready made, complete instrument drivers, developers and users need no knowledge concerning GPIB protocols for the individual system instruments.

As well as the Fluke and Philips instrument drivers, TestTeam includes a number of drivers for instruments from other suppliers. The user can also write his own drivers, or control the GPIB bus at bus level using the TestTeam commands. This allows tailoring of the application program with no loss of flexibility.



The above function panel for a Philips or Fluke digital multimeter, here with the instrument identity DMM1, allows direct selection of the desired measuring functions. The function call(s) corresponding to the selected instruments functions are automatically generated by TestTeam and displayed under the function panel. These function calls can then be executed with the "Go!" command or be inserted in the application program at the present location of the cursor.

Ready to Use Graphics and Analysis Libraries

Libraries for graphical presentation and analysis of measurement data provide the programmer with a number of standard functions. Drawing a graph, calculating a standard deviation is now simply a matter of filling in the blanks of a function panel. For more advanced analysis functions, like FFT, integration, differentiation, correlation, convolution, RMS and many more, there is the optional PM 2241 Advanced Analysis Package.

Reduced Debugging Time

As well as providing a clear and convenient environment for writing test prgrams, TestTeam allows fast, effective program testing, with built-in facilities for syntax checking and interactive debugging. Sections of the program can be executed step by step or tested separately. Breakpoints can be inserted and program variables can be examined and changed to speed debugging.

Programming Environment Tailored for GPIB

TestTeam offers three windows for program editing and testing. The program window offers a full-screen editor, which supports fast and efficient program modification. The interactive window permits the user to execute and debug a section of his application program, and the standard Input/Output window provides an area for

---

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

input and output during execution of an application program. Any two of these windows can be displayed simultaneously.

Programs created with TestTeam can not only be executed within the TestTeam environment, but can be saved as QuickBASIC or C files which can be compiled for execution in a different environment. The only option required is the instrument library for the selected programming language (PM 2231 for Microsoft C and PM 2233, for QuickBASIC see page 376). As a new and simple to use tool for GPIB program development, TestTeam saves time and is the most cost effective solution.

System Requirements

IBM PC/XT/AT or compatible, or IBM PS/2 Model 30 with MSDOS:

- Minimum 640 kbytes of memory, a floppy and hard disk drive
- IBM CGA, EGA or VGA, Hercules monochrome or compatible graphics adapters to execute graphics functions
- Philips PM 2201/99 or National Instruments PC-IIA/PC-IIB GPIB interface cards (see page 379)

IBM PS/2 Model 50, 60, 80 with MSDOS:

- Minimum 640 kbytes of memory, a floppy and hard disk drive
- Philips PM 2202/99 or National Instruments MC-GPIB interface cards (see page 379)

Ordering Information

Models

January 1989 prices

PM 2240/001 TestTeam	$925
PM 2201/99 GPIB interface for PC	399
PM 2202/99 GPIB interface for PS/2	499

Options

PM 2241/001 TestTeam Advanced Analysis Library (optional)	$995

Note: The above configurations meet North American power requirements. For other power options, see page 491.

The following are registered trademarks:
Labwindow: National Instruments
PC/XT/AT, PS/2: IBM Corporation
Hercules: Hercules Computer Technology Inc.
Microsoft, MS-DOS, QuickBASIC: Microsoft Corporation

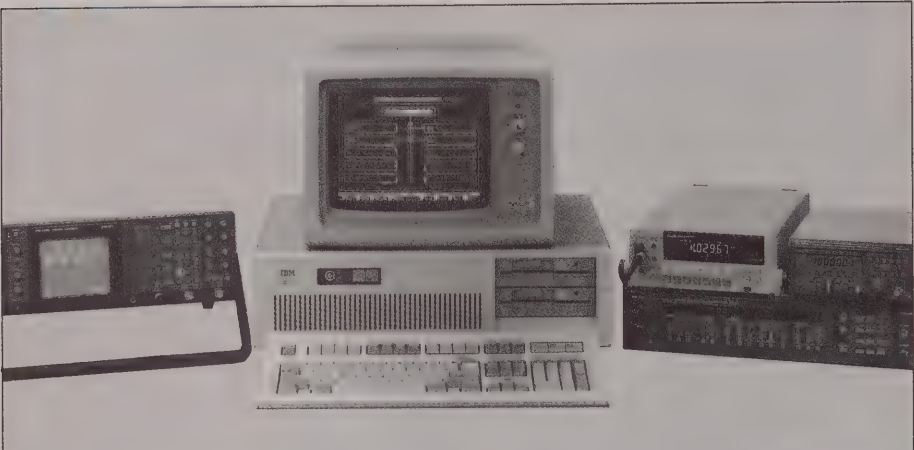
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

PM 2230 Series

NEW



PM 2230 Series

PM 2230 Series Instrument Drivers

- Automatic configuration utility for fast system configuration
- High level instrument commands ease programming and debugging
- Extensive built-in error checking and reporting
- Includes easy to use GPIB/IEEE-488 drivers
- Support for BASICA/GWBASIC, QuickBASIC, Pascal and C
- Available for IBM PC's and PS/2

GPIB/IEEE-488* system programming is simplified by the Philips Instrument Drivers for the IBM PC or PS/2 computers equipped with Philips GPIB interfaces (see page 362). These drivers cover a range of specific Fluke and Philips GPIB instruments, including multimeters, frequency generators and synthesizers, digital storage oscilloscopes (DSOs), counters and switch units. Included in the instrument driver packages are GPIB procedures to program instruments not supported with specific drivers.

Auto-Configuration Utility

The auto-configuration utility automatically determines the GPIB system configuration, including instrument addresses and type, and assigns a user defined name to each instrument. After running this utility, the user can write his application program with the knowledge that the system is correctly configured.

Fast and Simple Development and Debugging of programs

High-level instrument commands, which are just as simple as using the front panel of the instrument, free the user from the task of learning the different GPIB mnemonics of each instrument and the details of GPIB control. This allows the user to concentrate on the application itself instead of the subtleties of GPIB programming.

Instrument drivers enhance the readability of the program. This results in code that is self-documenting and very easy to understand. Hence the use of instrument drives reduces time spent on program debugging and maintenance.

Instrument drivers also automatically check command validity. For example out-of-range parameters are trapped, resulting in error-free instrument operation.

```
1400 'Send the generator a new frequency between 50 Hz
1410 'and 1 kHz and have the counter take a reading.
1420 'Perform this action 20 times.
1430   FOR FREQ = 50 TO 1000 STEP 50
1440     CALL SET.FREQUENCY(GNR1, FREQ)
1450     CALL MEASURE(CNT1, VALUE)
1460     PRINT "Frequency = "; VALUE; " Hz"
1470   NEXT FREQ
```

"An example of code written using Instrument Drivers."

Supported Languages

Instrument drivers are available for the languages BASICA/GWBASIC (PM 2230), Microsoft C (PM 2231), Microsoft Pascal (PM 2232) and QuickBASIC (PM 2233). Instrument drivers for DSOs , supporting all languages, are available in a separate package, the PM 2235.

Supported Instruments

For PM 2230/31/32/33:
- Multimeters: Philips PM 2525/33/34, Fluke 8840/42
- Generators: Philips PM 5191/92/93, Fluke 6060/62**
- Counters: Philips PM 6652/52C/54/54C/65/66/69
- Switches: Philips PM 2120/21/22/23/24/2

For PM 2235:
- DSOs: PM 3320A/50/65

Philips continuously extends the range of instruments supported by their software packages.

System Requirements

IBM PC/XT/AT or 100% compatible and PS/2 Model 30 with MSDOS:
- Minimum 512 kbytes memory, a floppy and a hard disk drive
- Philips PM 2201/99 or National Instruments PC-IIA/IIB GPIB interfaces (see page 379)

IBM PS/2 model 50/60/80 with MSDOS:
- Minimum 512 kbytes memory, a floppy and a hard disk drive
- Philips PM 2202/99 or National Instruments MC-GPIB interface cards (see page 379)

For PM 2230: BASICA/GWBASIC rel. 2.02 or higher. PM 2231: Microsoft C rel. 4.00 or higher. PM 2232: Microsoft Pascal rel. 3.32 or higher. PM 2233: Microsoft QuickBASIC rel. 4.0

Ordering Information

Models

January 1989 prices

PM 2230/001 Instrument drivers for BASICA/GWBASIC	$590
PM 2231/001 Instrument drivers for C	590
PM 2232/001 Instrument drivers for Pascal	590
PM 2233/001 Instrument drivers for QuickBASIC	590
PM 2235/001 Oscilloscope Instrument Drivers***	495
PM 2201/99 GPIB interface for PC	399
PM 2202/99 GPIB interface for PS/2	499

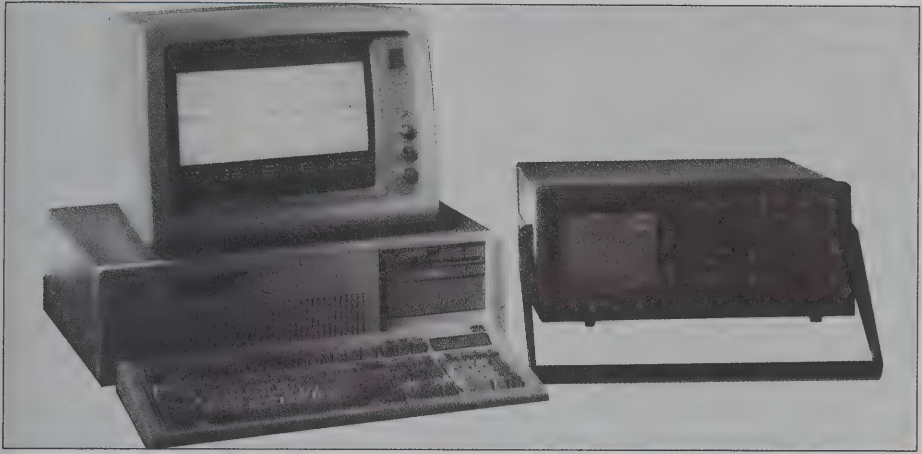
The following are registered trademarks:
PC/XT/AT, PS/2: IBM Corp.
Microsoft, MS-DOS, QuickBASIC: Microsoft Corp.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

***The Fluke 6060 & 6062 will be supported in Feb. 1989.*

****For use with the PM 2230, PM 2231, PM 2232 & PM 2233. Requires one of the above instrument driven packages.*

NEW

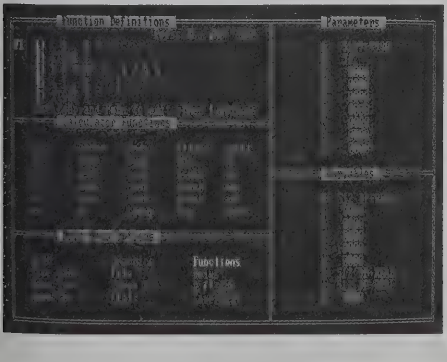


PM 2260 Oscilloscope Signal Processing

- Extensive waveform analysis and display functions all accessible via menus and function keys
- Menu driven data communication for Philips DSOs
- Data capture and analysis of waveforms
- Fast data transfer via GPIB/IEEE-488
- On-line help facility
- Available for IBM PCs

The PM 2260 Oscilloscope Signal Processing package is a complete software package for the analysis of measurement data from Philips Digital Storage Oscilloscopes (DSOs) on PCs. It is a combination of DSO drivers tailored for data transfer from the DSO to the PC and the ASYSTANT-GPIB™ software package.

ASYSTANT-GPIB is menu structured and offers an unprecedented range of mathematical, waveform analysis and processing, statistics, text editing, graphic functions and GPIB/IEEE-488* programming capabilities. An on-line help facility makes this powerful ready-to-run package very easy to use and increases the application range of Philips DSOs.

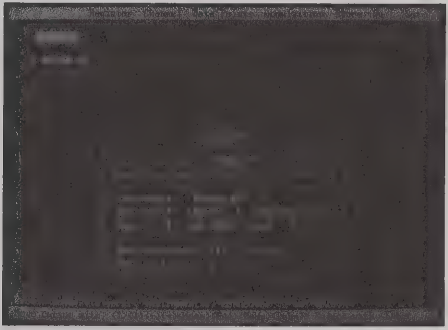


Data Transfer

Data can be transferred from the DSO to the PC via two methods. The first method uses menu-oriented instrument drivers for Philips DSOs which allow a user to simply select parameters like DSO channel, DSO register and number of data points via a menu. Channel, register, number of data points and name of destination file are the most important parameters which have to be entered in the data transfer menu. The result is a file on the PC with all the available and scaled information on the captured waveform. With the Philips DSO drivers no programming skill or effort is required.

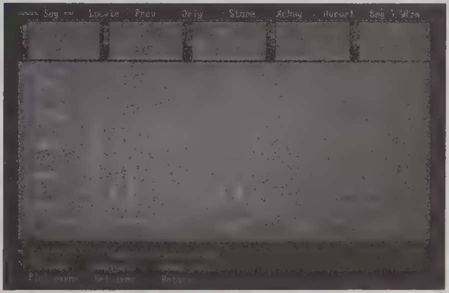
The second method involves using the built-in GPIB programming power of ASYSTANT-GPIB. ASYSTANT-GPIB allows a user to program the PC to capture a waveform from the DSO, scale the waveform and perform analysis all in real time. The user can create up to 30 different GPIB programs, which can call each other, enabling the user to build sophisticated GPIB programs.

Both of the two data transfer methods provide the user with support for the following Philips DSOs: PM 3308, PM 3320/20A, PM 3335, PM 3340, PM 3350 and PM 3365. The Philips DSO drivers provide support by including menu-oriented instrument drivers for each of the supported DSOs. Support for the GPIB programming power of ASYSTANT-GPIB is provided by including GPIB programs for each DSO showing how to capture and scale a waveform from the DSO.



Mathematics

The PM 2260 includes a full function array-based scientific calculator supporting single and double precision reals, integers and complex numbers. The many available functions include arithmetic functions, conversions (complex/real imaginary, complex/polar, polar/cartesian, cartesian/sperical), array operations (generating, editing, rotating, plus many more), and matrix and waveform analysis operations (FFT, inverse FFT, power spectrum, smooth, integration, differentiation, averaging, standard deviation, plus many more).



Waveform Processing

The waveform processor offers an extensive range of functions to interactively analyze signals captured with the DSO. On-screen graphic cursors isolate waveform segments and "visual" memories hold intermediate results. The processing functions include smoothing, enveloping, area under the curve calculations, power spectra, plus many more.

Graphics

On-screen graphical representation is vital for thorough data analysis. The PM 2260 offers a large number of graphic functions enabling the user to tailor the data representation to the format most suited to his application. Graphic functions include multiple windows, auto plotting

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

and scaling, linear, log and semi-log plots, axonometric and contour plots, labeling in eight directions plus many more.

. . .and More

Other standard PM 2260 functions include statistics, differential equations and polynomials. All signals and values can be stored on the PC, or output to a printer or plotter. The PM 2260 includes ready-to-run software drivers for popular printers with a centronic interfaces and HPGL plotters with serial interfaces.

System Requirements

IBM PC/XT/AT or 100% compatible and PS/2 model 30:

- Minimum 640 kbytes memory.
- Floppy disk & hard disk
- 8087, 80287 or 80387 math coprocessor
- Philips PM 2201/99 (see page 379) or National Instruments PC-IIA/IIB GPIB Interface Card

Ordering Information

Models

January 1989 prices

PM 2260/002 Oscilloscope Signal Processing software package	$795
PM 2201/99 GPIB Interface for PCs	399

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Notes:

The above configurations meet North American power requirements. For other power options, see page 491.

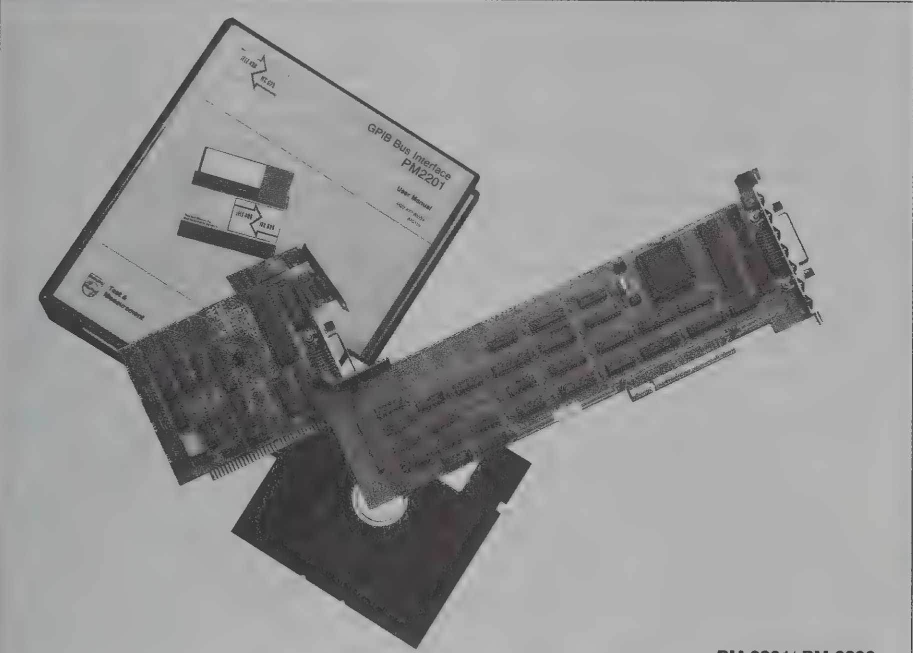
PC/XT/AT, PS/2 is a registered trademark of IBM Corporation

MS-DOS is a registered trademark of Microsoft Corporation

ASYSTANT-GPIB: is a registered trademark of Asyst Software Technologies

PM 2201/PM 2202

NEW



PM 2201/ PM 2202

PM 2201 & PM 2202 GPIB/IEEE-488 Interfaces for PC and PS/2

- Turns IBM PC's and PS/2's into versatile GPIB/IEEE-488 controllers
- Includes easy to use GPIB/IEEE-488 drivers for BASICA, Pascal and C
- Supported by PM 2230 Series, PM 2240 and PM 2260 software packages for easy programming of GPIB/IEEE-488 instruments
- Supported by a large range of software packages from other suppliers

Hardware

The PM 2202 contains the extremely advanced MC-GPIB interface from National Instruments, for the IBM Personal System/2 equipped with Micro Channel plug-in slots. The PM 2201 contains the widely used PC-IIA GPIB interface from National Instruments for the IBM PC/XT/AT and 100% compatibles. Installing the cards is very simple and with the PM 2202, all settings are software programmable using the PS/2 Programmable Option Set facility.

Software

PM 2201 and PM 2202 include a set of GPIB/IEEE-488* drivers for writing application programs in GWBASIC/BASICA, Microsoft C and Microsoft Pascal. These GPIB routines include all commonly used functions like bus initialization, sending commands, sending and receiving messages, remote and local instrument setting, serial polling, time-out setting and others. Error checking is included in all drivers to enhance program reliability.

PM 2201 and PM 2202 are software compatible, so that a program developed on a PC with the PM 2201 will also run on a PS/2 equipped with a PM 2202 and vice versa. This greatly extends the use and life cycle of application programs.

System Requirements

For PM 2201: IBM PC/XT/AT or 100% compatible or PS/2 Model 30:
- Minimum 256 kbytes of memory, a floppy and hard disk drive
- GWBASIC/BASICA rel. 2.02 and higher or Microsoft Pascal rel. 3.32 and higher or Microsoft C rel. 4.00 and higher

For PM 2202: IBM PS/2 Model 50/60/80:
- Minimum 256 kbytes of memory, a floppy and hard disk drive
- GWBASIC/BASICA rel. 2.02 and higher or Microsoft Pascal rel. 3.32 or Microsoft C rel 4.00 and higher.

Ordering Information

Models

January 1989 prices

PM 2201/02 GPIB Interface for PC including GPIB Driver Software	$595
PM 2201/52 GPIB Drivers Software for PC with PM 2201/99 or National Instruments PC-2A/2B	260
PM 2201/99 GPIB Interface for PC, without software	399
PM 2202/01 MC-GPIB Interface for PS/2 including MC-GPIB Driver Software ...	695
PM 2202/51 MC-GPIB Drivers for PS/2 with PM 2202/99 or National Instruments MC-GPIB	260
PM 2202/99 MC-GPIB Interface for PS/2, without software	499

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

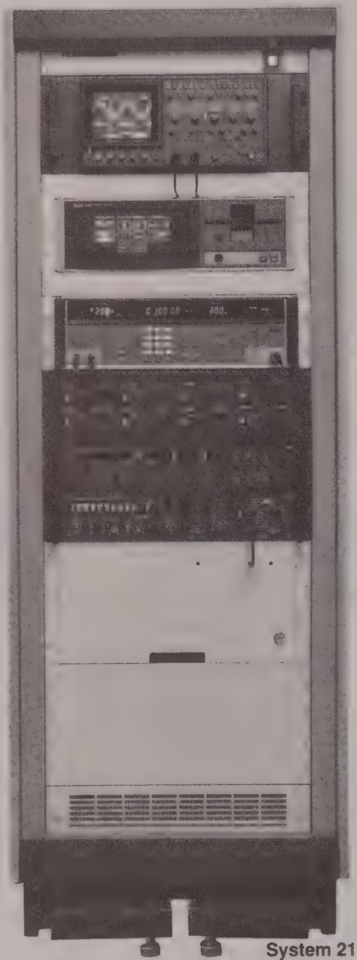
Note: The above configurations meet North American power requirements. For other power options, see page 491.

The following are registered trademarks:
PC/XT/AT, PS/2: IBM Corporation
Hercules: Hercules Computer Technology Inc.
Microsoft, MS-DOS, QuickBASIC: Microsoft Corporation

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

System 21

GPIB IEEE-488



System 21

System 21 Modular GPIB Switching System

For small/medium-size instrumentation systems

Applications areas include:

- Research & development labs
- Quality control
- Small-scale production
- Education

A Simple System, Any Way You Stack It

Until now, automatic GPIB/IEEE-488* switching systems came in two varieties: big, but expensive, and small, but limited.

Now the Philips System 21 fills the gap with an expandable modular system that fits both your projects and your budget. And it fits your benchtop too.

System 21 is a complete family of fifteen stackable intelligent modules, each suited to a special function, all tied to a single GPIB address, all completely computer controlled.

It's so easy to use that you'll cut learning time dramatically compared to most mainframe systems. And it's so easy to change that you can perform nearly any small or midrange automated tests with ease.

Buy Only the Functions You Need

Perhaps the best thing about System 21 is that you need not buy a complete system to get the functions you want.

You can begin with just two units – a master and slave – and then expand as your needs grow. Start with, say, the master unit and a universal switch, then later add a digital input/output unit, then an 18 GHz switch, then maybe a user-configurable module for those special functions that you need from time to time.

You decide what you need, and buy only when you need it.

Easy to Start. Easy to Expand

The cost to begin building your system is naturally far less than for mainframe switching systems. So you get both the flexibility of mainframes and the affordability and convenience of off-the-shelf components.

And the cost to expand your system is lower still. You needn't break your budget to add functions.

On the Bench

System 21 is a great tool for prototype testing and benchtop experiments of all kinds.

Working with even a single multimeter and PC, System 21 brings affordable, verstile automatic switching to research and development departments and engineering staffs. Without the needless expense of mainframe switching systems, without the hassle of do-it-yourself switches.

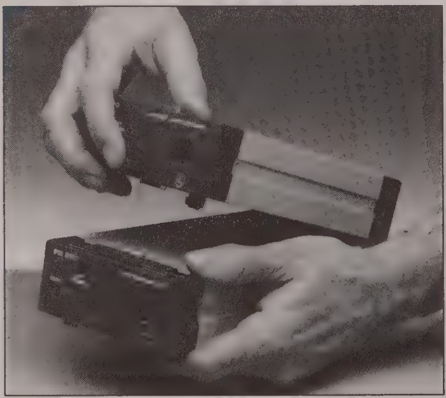


Figure 1

Or in the Rack

In production environments System 21 can be rack mounted for larger instrumentation systems, handling switching and I/O functions too small to warrant expensive mainframe equipment.

Also, System 21's modular design and easy software control allow quick reconfiguration for a host of different tasks. Production testing has never been so flexible.

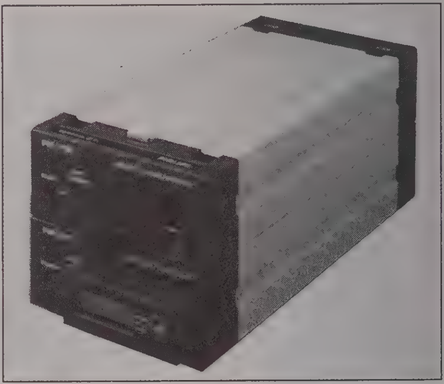


Figure 2

The System Behind the System

System 21 consists of a master module and up to fifty slaves, all tied to a single GPIB address.

The modules snap together top and bottom for easy connection, but they can be cabled as well.

Simple commands control everything. Each module works independently, and each can store commands, which can be triggered later by the controller.

That means simpler programming, and far less coding of repetitive tasks.

The following three command strings, written on a Fluke 1722A Instrument Controller

```
PRINT @7, “AID 203; CLOSE 4-6, OPEN 3”;
PRINT @7, “AID 201; MODE 00, OPEN 5, CLOSE
1”;
PRINT @7, “AID 301; STATUS ?”
```

are command strings to System 21 at GPIB address 7 with messages for:

PM 2120 with System 21 address 3 to CLOSE contacts 4, 5 and 6 and OPEN contact 3.

PM 2120 with System 21 address 1 to go to MODE 00 and OPEN contact 5 and CLOSE contact 1.

PM 2131 with System 21 address 1 to send STATUS information

Most modules have multiple operating modes, too. So you can make your system even more flexible by configuring each module several ways.

The Universal Switch, for instance, can be configured three ways; for twenty individual on/off switches, ten break-before-make switches or

---

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

ten make-before-break switches. Similarly, digital input/output modules can be used in either direct or latching modes.

And all modules feature multiple execution modes, including a scan mode to activate individual switch inputs in sequence with minimum coding – another way to simplify your work.

Simple Yet Flexible

GPIB testing has never been so easy. You control all of System 21 through on master unit, using one controller and easy-to-use software. Intelligence is distributed throughout the system for easy programming. And you can reconfigure in a thousand ways.

It's one system you can't beat.

Specifications

Mechanical Construction: All units are housed in a separate box. Mechanical interconnection to the master and other units is by means of a bolt construction in the feet of each unit.
Dimensions: 105 mm W x 44.4 mm H x 226 mm L (4.3 in W x 1.7 in H x 8.9 in L) (excluding connectors and feet)
Height of Feet: 11 mm (0.43 in)
Display Module: The optional PM 2190 Display Module can be plugged into the front panel socket of each unit, to provide status information.
Terminal Connector: One or more terminal connectors are provided on the rear panel of each unit

Environmental Data

Operating Temperature: 0 + 55°C
Storage Temperature: -40 + 75°C
Humidity 80%: (0 + 55°C)
Dewpoint: 25°

Module Specifications

PM 2101 Master Unit

The PM 2101 Master Unit provides the power supply to the complete system and handles communication between the GPIB interface bus and the System 21 internal bus.

Bus Communication

Communication between the GPIB bus and the internal bus is fully transparent. Messages addressed to the Slave Units are not influenced by the Master Unit.

Power Supply

Power: 110, 120, 220 or 240 VAC ±10%, 50 or 60 Hz
Power Consumption: 16 VA max
Safety: Class II acc. to IEC 348
Secondary Power Supply to Slave Units: 7.5V (at full load) to 15V (unloaded)
Maximum Current Load: 750 mA (If higher currents are needed, additional PM 2198 power supply units can be used in parallel).

System Control Functions

Control functions of the Master Unit include identification, synchronization and service request handling.

Identification

On request, the Master Unit returns with:
a. Type number and version of the Master Unit
b. List of connected Slave Units

Trigger Facilities

Trigger commands from the GPIB bus can be distributed at choice to:

- Individual units
- All units with identical type numbers
- All units

If required, these trigger commands can be delayed until the ready line is "true".

Reading the Ready Line

On request, the Master Unit returns with the status of the ready line.

Resetting the System

The system can be reset to power-on conditions via the GPIB bus, or by means of a (protected) reset button on the Master Unit.

Service Request Handling

The Master Unit includes masking facilities to select from several reasons for service request messages. These include

- Power failure or illegal code
- Addressed unit is not present or has synchronization error
- A unit has data available, has reached end of block or has a functional warning
- Changes in ready or trigger line

The Master Unit returns with detailed information on the source of the service request call by means of a polling procedure after a service request is received.

GPIB Interface Data

Interface functions:

Description	Function	Capability
Source handshake	SH1	Complete
Accepter handshake	AH1	Complete
Talker function	T6	No talk only
Listener function	L4	No listen only
Service request	SR1	Complete
Remote/Local	RLO	No local control
Device clear	DC1	Complete
Device trigger	DC1	Complete

Address setting: 10 to 19

Accepted input data:

- Control data for Slave Units, Master Unit and interface
- General multiline commands; DCL, SPE, SPD, GET, SDC

Output Data: Functional messages, status and error messages of the units.
Separators: Record separators can be software programmed to one or two characters. At power-on, record and block separator are "NL".
Service Request: The following reasons for a service request can be enabled or disabled under software control: illegal header or body, System 21 request.
Connector: Standard GPIB connector.

PM 2120 Universal Switch

The PM 2120 Universal Switch offers 20 switches grouped in 10 pairs, each with a common contact. Depending on the switching mode setting, the switches can be used as:

- 20 individual on/off switches with one common contact per pair; or
- 10 single pole double throw (SPDT) break-before-make or make-before-break switches.

The contacts are high quality reed relays able to handle 200 mA, 30V and frequencies up to 100 kHz.

Technical Specifications

Configuration: 10 elements of 2 switches with a common output
Operating Modes
Mode 0: 20 individual switches (with common output per pair) for multiplexing or matrix switching
Mode 1: 10 SPDT make-before-break
Mode 2: 10 SPDT break-before-make
Max. Switching Voltage: 30V rms
Max. Switching Current: 200 mA
Max Switching Power: 10 VA (resistive load)
Max. Common Mode Voltage between Terminals or between Terminal and Ground: 30V rms AC or 40 VDC
Frequency Range: DC to 100 kHz
Series Resistance: <0.5Ω
Open Contact Resistance: $>10^9\Omega$
Isolation Resistance: $>10^9\Omega$
Crosstalk Isolation: 60 dB at 100 kHz, R_0=50Ω
Switching Time Individual Relay: <10 ms, until last relay has settled in any mode: <25 ms, break-before-make or make-before-break; 10 to 20 ms
Terminal: 37-pin female D-type connector
Display Module: The optional RM 2190 Display Module shows

- Switching mode, synchronization mode and ready status
- Settings of individual switches

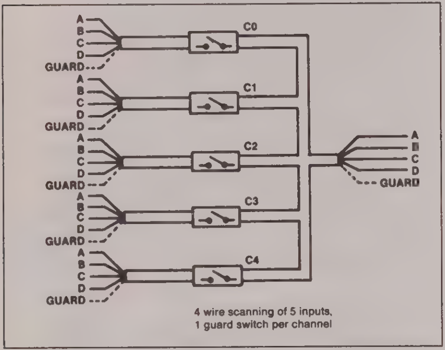
Current Consumption for System Supply: 25 mA (all switches open) to 125 mA (all switches closed)

PM 2121 Low-Level Switch

The PM 2121 Low-Level Switch offers 5 switches (each 4 wires + guard) at the input, and mode-switching at the output. Depending on the switching mode, the switches can be used for scanning of:

- 20 channels of 1 wire + guard (guard in common for 4 channels)
- 10 channels of 2 wires + guard (guard in common for 2 channels)
- 5 channels of 4 wires + guard

Switch contacts are matched to the special requirments of switching at low signal levels. The thermovoltage is <3 µV



4 wire scanning of 5 inputs, 1 guard switch per channel

Technical Specifications

Configuration: 5 elements of 4 contacts + guard at the input and a mode switching unit at the output

Operating Modes

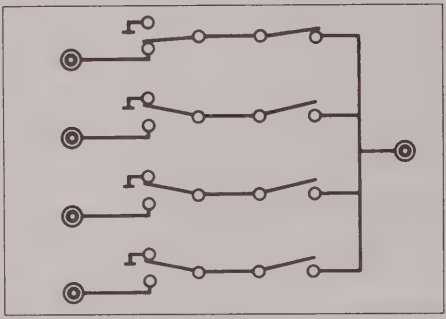
Mode 1: 1 wire (+ guard) scanning of 20 inputs
Mode 2: 2 wire (+ guard) scanning of 20 inputs
Mode 4: 4 wire (+ guard) scanning of 5 inputs. A common guard for 4 contacts is used in all modes
Max. Switching Voltage: 24V rms
Max. Switching Current: 500 mArms
Max. Switching Power: 12 VA (up to 1 MHz)
Max. Common Mode Voltage Terminals or between Terminal and Ground: 24V rms AC or DC
Frequency Range: DC to 1 MHz
Series Resistance: <1Ω
Open Contact Resistance: $>10^9\Omega$
Isolation Resistance: $>10^9\Omega$
Crosstalk Isolation: >90 dB (50/60 Hz); >40 dB (1MHz)
Switching Time Individual Relay: <10 ms, until last relay has settled in any mode: <25 ms
Order of Contact Closure and Opening: Input guard, input contacts, output guard, output contacts and inverted
Terminal: 37-pin female D-type connector
Display Module: The optional PM 2190 Display Module shows

- Switching mode, synchronization mode and ready status
- Selected channel

Current Consumption from System Supply: Typcial 25 mA, max. 50 mA

PM 2122 50Ω Coaxial Switch

The PM 2122 50Ω Coaxial Switch Unit offers facilities for the selection of one of four inputs to the output.
The unit is suitable for switching VHF signals up to 500 MHz and 24 V rms. Matching impedance is 50Ω



Technical Specifications

Switch Configuration: 4 single pole double throw switches selecting 1 of 4 inputs
Operating Mode: Fixed
Matching Impedance: 50Ω (open inputs are not terminated)
Max. Switching Voltage: 24V rms AC
Max. Switching Current: 250 mA rms
Max. Switching Power: 3 VA (50Ω load)
Max. Common Mode Voltage between Terminals or between Terminal Ground: 24V rms AC or DC
Frequency Range: DC to 500 MHz
VSWR: <1.2 at 100 MHz; <1.5 at 500 MHz
Series Resistance: <1Ω
Open Contact Resistance: $>10^8\Omega$
Isolation Resistance: $>10^8\Omega$
Crosstalk Isolation: >50 dB at 100 MHz, >25 dB at 500 MHz
Switching Time Individual Relay: <10 ms, until last relay has settled: <25 ms
Terminals: 50Ω BNC connectors
Display Module: The optional PM 2190 Display Module shows

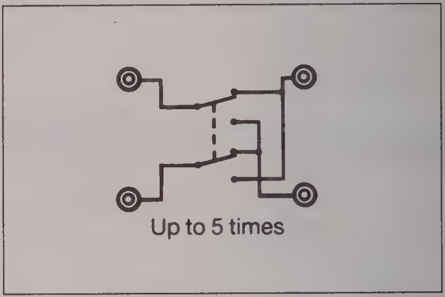
- Synchronization mode and ready status
- Selected channel

Current Consumption from System Supply: Typical 35 mA, max. 60 mA

PM 2123 18 GHz Switch

The PM 2123 18 GHz Switch Unit provides facilities for driving up to five microwave switches, one of which can be mounted inside the PM 2123. Four others (or all five) can be connected via connectors.

As supplied, PM 2123 includes one switch mounted inside the unit. Additional switches can be ordered separately under part number PM 7551 (switch type as included with PM 2123) or PM 7550 (see separate specification).



Technical Specifications

Switch Configuration: 2 inputs and 2 outputs enabling straightforward or cross connection
Operating Mode: Fixed
Matching Inpedance: 50Ω
Max. Switching Power: 15W average, <1 kW peak
Frequency Range: DC to 18 GHz
VSWR: <1.1 at 1 GHz, <1.5 dB at 18 GHz
Isolation: >80 dB at 1 GHz, >60 dB at 18 GHz
Insertion Loss: <1.1 dB at 1 GHz, <1.5 dB at 18 GHz
Switching Time Individual Relay: <40 ms
Min. Time Between Successive Switch Operations: 500 ms
Terminals: 50Ω SMA jack
Display Module: The optional PM 2190 Display Module shows

- Synchronization mode and ready status
- Selected channel

Current Consumption From System Supply: Typical 35 mA, max. 60 mA
Specification of PM 7550 When Driven by PM 2123: Switch configuration. SPDT with 2 inputs.

PM 2124 High Current Switch

The PM 2124 High Current Switch offers 6 independently controlled bistable switches in groups of three connected to two terminals. It can switch AC power up to 2500 VA and DC up to 300W. The high current switch is for testing motors and other electro-mechanical devices, and the switches are provided with earth connections. They meet the IEC 348, Class 1 safety specifications.

Technical Specifications

Configuration: 6 independently controlled bistable switches in 2 groups of 3
Operating Mode: Fixed
Max Switching Voltage: 250 Vrms AC, 400 VDC
Max. Switching Current: 10A AC at up to 250V 10A DC at up to 30V 25A per terminal
Max. Switching Power: 2500 VA AC, 300W DC
Contact Resistance: 50 MΩ relays only 25 mΩ (including wiring and terminal)
Isolation Resistance: 2 MΩ
Cross Talk Isolation: Negligible up to 1 kHz
Inrush Current: 50A
Switching Time: Bistable relays switched in sequence - total switching time 50 ms + (n x 50 ms) for n contacts
Terminals: 2 x Amphenol series 97 terminals. Two corresponding plugs also supplied
Display Module: Optional PM 2190 shows position of relays.
Current Consumption From System Supply: Typically 25 mA

PM 2125 Probe Switch Driver

Where oscilloscope measurements have to be made at a number of points in an automatic GPIB system, the available instrument input channels often form a limitation. Now, with the PM 2125 Probe Switch Driver and PM 2195 Probe Switch, a single-channel instrument can accept up to four separate inputs, while the capacity of a four-channel oscilloscope can be increased to 16 inputs.

The PM 2125 Probe Switch Driver allows up to 4 PM 2195 Probe switches, for a total of 16 probes, to be connected to a GPIB system. Programming of the probe driver is made very simple by easy-to-interpret command strings. The probe switch driver is made very simple by easy-to-interpret command strings. The probe switch driver can operate in two modes: one for individual probe selection, and the other for parallel probe switching. The optional PM 2190 Display Module can show either the selected probes, the operating mode or the probe and switches that are not present in the system.

Technical Specifications

Operating Modes: 1 - individual probe selection. 2 - parallel switching of corresponding probes from 4 switches.
Contact Closure: Automatic closing of the 'ON' probe when a new probe is selected in the same probe switch unit
Switching Time: 50 ms
Read Back Facilities: Status of received commands: warning of illegal commands; warning of probe/switch selected but not present
Display Module: (optional PM 2190): Shows selected probes; operating mode; probes and switches not present
Current Consumption: 70 mA

PM 2195 Probe Switch

The PM 2195 Probe Switch provides an answer to problems which occur when waveforms are switched in typical GPIB systems. In general, switching waveforms before the signal is applied to the input probe causes load and interference problems, and switching between probe and oscilloscope input results in a significant degradation of bandwidth.

The PM 2195 Probe Switch consists of a 4-input selector switch and 4 attenuator probes. The switch is so compact that it can be plugged directly into the oscilloscope input socket and offers 4 probe inputs with individual adjustment facilities. Each probe can therefore be tuned for optimum response, so that a bandwidth of 400 MHz (3 dB) is ensured with an oscilloscope which has an input capacitance of less than 10 pF. As a result, only slight degradation of the bandwidth (5%) takes place for oscilloscope up to 300 MHz.

Technical Specifications

Input Probes

Number of Probes: 4
Attenuation Factor: 10 ±2%
Input Impedance: 10 MΩ/13 pF
Bandwidth: Including switch for scope with input capacitance <10 pF: DC to 400 MHz
Cable Length: 1.5 mP
Remote Probe Switch Required Output Load: 1MΩ//9 to 35 pF
Switch Control: PM 2125 probe switch driver (GPIB) or directly with 5V/12 mA supply

PM 2130 Digital I/O Unit

The PM 2130 Digital Input/Output Unit provides 8-bit input and output with optical isolation for signal levels from 0-5 to 0-30V. Outputs can be loaded up to 100 mA. The inputs can be used as latching input, and can set a warning flag when they match a reference pattern.

Technical Specifications

Configuration: 2 groups of 4-bit input and 1 group of 8-bit output with a common return line per group
Operating Modes
Mode 0: 8 input bits and 8 output bits
Mode 1: 8 latching input bits and 8 output bits
Latching Mode: In the latching mode a latch is set when the corresponding input is high for a period of >1 ms. The latches are reset by the RSL command.
Reference Facility: By setting a reference for the individual inputs to "dont' care", Low, High or changing state, a matching input or a change in input can be detected. The corresponding warning flag can be used to generate a service request message.
For Input/Output Details: See Table 1

Timing

Response Time on Setting Commands:<8 ms
Response Time on Read Commands: <8 ms
Minimum Pulse Width to set "match reference" Flag: 5 ms
Minimum Pulse Width to Set Latch: 0.5 ms
Terminal: 37-pin female D-type connector
Display Module: The optional Pm 2190 Display Module shows

- Synchronization mode and ready status
- Data sent to the output
- Logic states of the inputs

Current Consumption: <100 mA

PM 2131 Digital Input Unit

The PM 2131 Digital Input Unit provides 16-bit optically isloated input subdivided into 4 groups of 4 bits. Signal level is 0-5 to 0-30V. The inputs can be used as latching input. The inputs can be compared with preset reference to check on state or change of state.

Technical Specifications

Configuration: 4 groups of 4-bit input with optical isloation, and a common return line per group
Operating Modes
Mode 0: 16 input bits
Mode 1: 16 latching input bits
Latching Mode: In the latching mode a latch is set when the corresponding input is high for a period of <1 ms. The latches are reset by the RSL command.
Reference Facility: By setting a reference for the individual inputs to "dont' care", Low, High or changing state, a matching input or a change in input can be detected. The corresponding warning flag can be used to generate a service request message.
For Input/Output Details: See Table 1

Timing

Response Time on Setting Commands:<8 ms
Response Time on Read Commands: <8 ms
Minimum Pulse Width to set "match reference" Flag: 5 ms
Minimum Pulse Width to Set Latch: 0.5 ms
Terminal: 37-pin female D-type connector
Display Module: The optional Pm 2190 Display Module shows

- Operating mode, sychronization mode and ready status
- Logic states of the inputs

Current Consumption: <80 mA

PM 2132 Digital Input Unit

The PM 2132 Digital Output Unit provides 16-bit optically isloated output subdivided into 2 groups of 8 bits. Signal level is 0-5 for 0-30V. The outputs can be loaded up to 100 mA.

Technical Specifications

Configuration: 2 groups of 8-bit output with optical isolation, and a common line per group
For Output Details: See Table 1

Timing

Response Time on Setting Commands: <8 ms
Terminal: 37-pin female D-type connector
Display Module: The optional Pm 2190 Display Module shows
- Synchronization mode and ready status
- Data sent to the output

Current Consumption from System Supply: <200 mA

PM 2140 Analog Input

The PM 2140 Analog Input offers a 3-range input channel for DC voltages up to 25V, and a separate single-range current input up to 250 mA. The two inputs have a common floating low and are provided with a guard.

Maximum resolution is 10 µV in the 200 mV range and 10 µA in the current range. Measuring speed is 1.5 or 10 measurements per second. An input filter can be switched on for increased SMRR.

PM 2140 also includes two relays that can be activated by the input signal when passing a programmable high or low limit. The contacts of these relays are connected to rear-mounted terminals.

Technical Specifications

Configuration: 3-range DC voltage and single range DC current input with floating low and a guard. High and low limit detection with relays for external signalling.

Operating Modes

Mode 0: Measurements with 4 digit resolution
Mode 1: Measurements with 3 digit resolution
For Ranges and Accuracy: See Table 2

Limit Detection

Limit Setting Range: -25,000 to +25,000 counts
For both high and low limit:
  Max. Limit Relay Load: 10W
  Max. Voltage: 30V rms or 42 VDC
  Max. Current: 500 mA
Start of Measurements: Free-running or triggered via the systems bus. Measuring results are available 80 ms (mode 1) or 600 ms (mode 0) after start of measurement
Terminal: 37-pin female D-type connector
Display Module: The optional module PM 2190 shows:
- Operating mode, trigger mode and ready status
- Measured value
- High limit setting
- Filter on/off

Current Consumption from System Supply: Max.<100 mA

PM 2141 Digital Input Unit

The PM 2141 is a 12-bit Digital-to-Analog Converter, which offers a choice of both voltage and current output modes. The voltage output mode has two ranges, ±2V and ±20V and the current output mode has one range, ±20mA. The voltage and current output modes have a resolution of 2000 digits. Both of the outputs are floating with respect to the system and safety grounds. For safe operation, the output voltage must never exceed 42V (DC or DC + AC peak). The voltage output has optional separate sensing wires to eliminate voltage drop across the output wires. This option allows a power supply to be added to increase output power.

Technical Specifications

Programmed Output Voltage (Mode 1)

Output Voltage Range: -2 to +2 V
Current Range: -10 to +10 mA
Resolution: 10 mV (1:4000)
Accuracy: +(0.1% of value + 0.1% of range)
Output Impedance: 0.1Ω (or 1 mV/10 mA)

Programmed Output Voltage (Mode 2)

Output Voltage Range: -20 to +20V
Current Range: -10 to +10 mA
Resolution: 10 mV (1:4000)
Accuracy: +(0.1% of value + 0.05% of range)
Output Impedance: 0.1Ω (or 1 mV/10 mA)
Output Voltage (max): +20.5V

Programmed Output Current (Mode 3)

Output Voltage Range: -20 to +20 V
Current Range: -9 to +9 V
Resolution: 10 µA (1:4000)
Accuracy: +(0.1% of value + 0.05% of range)
Output Impedance: 0.1 µA/V
Output Admittance: 0.1 µA/V/K
Temperature Coefficient: +(0.0%/K of value +0.005%/K of range)

General Specifications

Response Time: Approx. 50 ms after master unit
Setting Time: Time between old and new output
Display Module: Optional display adapter PM 2190 shows:
- Mode
- Output voltage
- Output current

Input Voltage: 7 to 15 VDC
Current Consumption from System Supply: Approx. 200 mA at 12 VDC, no load approx. 250 mA at 12 VDC, max. load

PM 2160 Temperature Unit for Pt 100

The PM 2160 offers temperature measurment with Pt 100 sensores from -200°C to +850°C to a resolution of 0.1°C. The result is linearized and output in ASCII for direct input to a system controller.

Results can be compared to preset high and low limits. If they are exceeded, a warning is sent to the controller and the respective relay in the unit is activated.

Technical Specifications

Configuration: Single 4-wire connection to Pt 100 sensor. Current source/voltage input float w.r.t. main system
Operating Mode: Fixed
Measurement Range: -200°C to +850°C, resolution 0.1°C
Overload Indication: 999.9°C
Accuracy (not inc. sensor): +0.1% +0.5°C (-100°C to 850°C) +0.1% + 1°C (200°C to -100°C)
Temperature Coeff.: +(0.01% + 0.1°C)/°C
Common Mode Voltage: Floating sensor connection max. 30V rms or 42 Vpeak or DC w.r.t.
Measurement Time: 0.5s (-50°C to +250°C) 0.63S max. at -200°C 1.25s max. at +850°C
Measurement Trigger: Free running or triggered by systems bus
Limit Relay Output
  Max. Switching Voltage: 30V AC or 42V DC
  Max.Switching Current: 0.5 A
  Max. Switching Power: 10 W

Table 1. Input and Output Specifications for PM 2130, 2131, 2132

	Input	Output
Common Mode Voltage Between Groups and Ground	30V rms AC or 42 VDC	30V rms AC or 42 VDC
Supply Voltage	5 to 30V	5 to 30V
Supply Current	<10 mA (per group of 4 bit)	<1A (per group of 8 bits and including max. load current)
Logic	Positive	Positive (current source)
Levels	Low for <30% of supply voltage High for >70% of supply voltage	
Hysteresis	0.4V to 1.7V	
Input Voltage Range Input Resistance Input RC Time	-30 to +30V 100 kΩ 0.1 ms	
Max. Load Current		100 mA (outputs may be used in parallel)
Output Voltage		Supply voltage -1V at 100 mA load
Current at Output Low		<1 mA
Output Protection		Short-circuit protected and flyback diodes

Limit Parameters: The output can be compared with a high and low limit (+850°C or -200°C). Out of limit generates an SRQ signal for the controller, and activates high or low relays, accessible on the rear panel
Contact Resistance: 100 mΩ
Terminals: 37-pin female D-type connector
Display Module: Optional PM 2190 shows trigger mode and ready stauts; measured value (or overload); and high and low limit value
Current Consumption from System Supply: Max. 100 mA

PM 2150 User Adaptable Unit

The User Adaptable Unit allows the connection of a user-build function to the IEEE-488 bus. For this reason, fixing facilities, power supply and a connector for a standard Eurocard are provided in the unit. For interfacing to the user-build function, 16 I/O lines are available for use in most any configuration of inputs and outputs.

Technical Specifications

Configuration: Two groups of 8 I/O lines, read or written in groups, and with a common return
Signal Levels: CMOS 5V compatible with 10 kΩ pull-up
Power Supply: A maximum of 200 mA at 5V ±5% is available for user-build circuitry
Use of I/O Lines: The 16 I/O lines can be used in any I/O line configuration

Table 2. PM 2140 Ranges & Accuracy

	VDC 200 mV	VDC 2V	VDC 20V	IDC 200 mA
Reading Ranges				
Mode 0	±250.00 mV	±2.5000V	±25.000V	±250.00 mA
Mode 1	±250.0 mV	±2.500V	±25.00V	±250.0 mA
Max. Resolution	10 μV	100 μV	1 mV	10 μV
Accuracy: % of Reading ±% of Range	0.1 ±0.02	0.1 ±0.02	0.1 ±0.02	0.25 ±0.05
Temp. Coeff. %/°C	0.01	0.005	0.005	0.05
Input Characteristic	1 MΩ	10 MΩ	10 MΩ	1Ω
SMRR (at 50 Hz)				
Mode 0 filter on	>60 dB	>70 dB	>70 dB	
filter off	>40 dB	>50 dB	>50 dB	
Mode 1 filter on	>50 dB	>60 dB	>60 dB	
filter off	>30 dB	>40 dB	>40 dB	
Input Settling Time for Last Digit				
Mode 0 filter on	750 ms	750 ms	750 ms	450 ms
filter off	150 ms	150 ms	150 ms	100 ms
Mode 1 filter on	550 ms	550 ms	550 ms	350 ms
filter off	75 ms	75 ms	75 ms	75 ms
CMRR	100 dB at DC 80 dB at AC (50 Hz)	100 dB at DC 80 dB at AC (50 Hz)	100 dB at DC 80 dB at AC (50 Hz)	100 dB at DC 80 dB at AC (50 Hz)
Avg Measuring Speed				
Mode 0	1.6 per second	1.6 per second	1.6 per second	1.6 per second
Mode 1	10 per second	10 per second	10 per second	10 per second
Maximum Load	42 VDC (tested up to 250V rms)	42 VDC (tested up to 250V rms)	42 VDC (tested up to 250V rms)	1.5A average and 10A peak

Reference Facility: A matching state of I/O lines can be detected by reference setting. The corresponding warning flag can be used to generate a service request message. The reference pattern can consist of: "don't care", Low, High or "changing state" bits.

Timing

Response Time on Read or Write Command: <8 ms
Min. Pulse Width to set "match reference" Flag: 5 ms
Control Commands: All I/O lines can be set or read individually or in combination in binary, decimal, hexadecimal or ASCII code. The reference can be set in binary, decimal or hexadecimal codes ("don't cares" and "change state" in binary code only)
Display Module: The optional Display Module shows:

- Synchronization mode and ready status
- Data sent to the I/O lines
- Status of the I/O lines

Current Consumption from System Source: 50 to 250 mA depending on circuitry

Accessories

PM 2190 Display Module

The PM 2190 Display Module has an 8-digit LCD to show programmed modes and settings of the Slave Units during debugging. The module can be plugged onto the front panel connector of each Slave Unit.

(The parameters shown on the Display Module are specified for each Slave Unit).

PM 2191 Terminal Adapter

The PM 2191 Terminal Adapter adds a screw-connection terminal to Slave Units which have a 37-pin D-type terminal.

PM 2192 Extension Cable Set

A set of flat cables and connectors enabling the System 21 internal bus to be extended so that units can be used at different places in a rack. The set contains:

- 1M flat cable with an internal bus connector at one end
- 3 additional connectors

PM 2193 19"Rack-Mount Kit

This rack-mount kit allows up to 8 System 21 units to be mounted in a standard 3E high rack unit. Wiring for interconnection of the units is provided as standard.

PM 2194 Blank Panels for Rack-Mount Kit

PM 2194 provides blank panels for the PM 2193 Rack-Mount Kit. The rack-mount kit holds up to eight System 21 modules. If less than eight modules are used the blank panels will cover any of the empty locatons in the rack-mount kit.

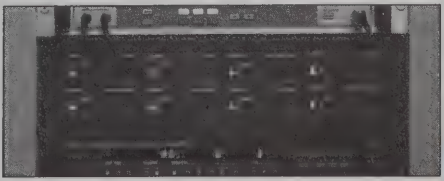
The PM 2194 provides enough pieces to cover seven locations of the rack-mount kit, if only one System 21 module was used.

PM 2198 Additional Power Supply Unit

In extensive systems requiring more current than the 750 mA capacity of the PM 2101 Master Unit, additional PM 2198 Power Supply Units can be connected in parallel. Each additional PM 2198 provides an additional 750 mA.

Technical Specifications

Power: 110, 120, 220 or 240 VAC ± 10%, 50 or 60 Hz
Power Consumption: 16 VA max.
Safety: Class II acc. to IEC 348
Secondary Power Supply for Slave Units: 7.5V (at full load) to 16V (unloaded)
Maximum Current Load: 750 mA



System 21

Ordering Information

Models

January 1989 prices

PM 2101/013 Master Unit	$690

Switches

PM 2120/01 Universal Switch	480
PM 2121/01 Low Level Switch	600
PM 2122/01 50Ω Coaxial Switch	680
PM 2123/01 1Ω Ghz Switch	995
PM 2124/01 Current Switch	680
PM 2125/01 Probe Switch Driver	450
PM 2195/09 Probe Switch	650

Digital I/O

PM 2130/01 Digital I/O Unit	$575
PM 2131/01 Digital Input Unit	575
PM 2132/01 Digital Output Unit	575

Data Acquisition & Custom Units

PM 2140/01 Analog Input Unit	600
PM 2141/01 Analog Output Unit	695
PM 2150/01 User Adaptable Units	395
PM 2160/01 Pt-100 Temperature Unit	600

Accessories

PM 2190/01 Display Unit	195
PM 2191/01 Terminal Adapter (qty: 3)	199
PM 2191/10 Terminal Adapter (qty: 1)	$70
PM 2192/01 Bus Extension Cables	60
PM 2193/01 Rack Mount Kit	235
PM 2194/01 Blank Panel for Rack Mount	80
PM 2198/013 Additional Power Supply	360

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

System 21 Selection Chart

Master and Custom Units							**Maximum Power**	**Connector Type**	**U.S. Price**	**Description**
PM 2101	GPIB Master Unit						16VA	GPIB	$690	Controls and powers up to 50 slave units. Uses only one GPIB address.
PM 2150	Customer Adaptable Unit						200 mA at 5V ±5%	Euroconnector for a Eurocard	$395	Allows the development of custom slave units. Uses 5V CMOS or TTL chips.

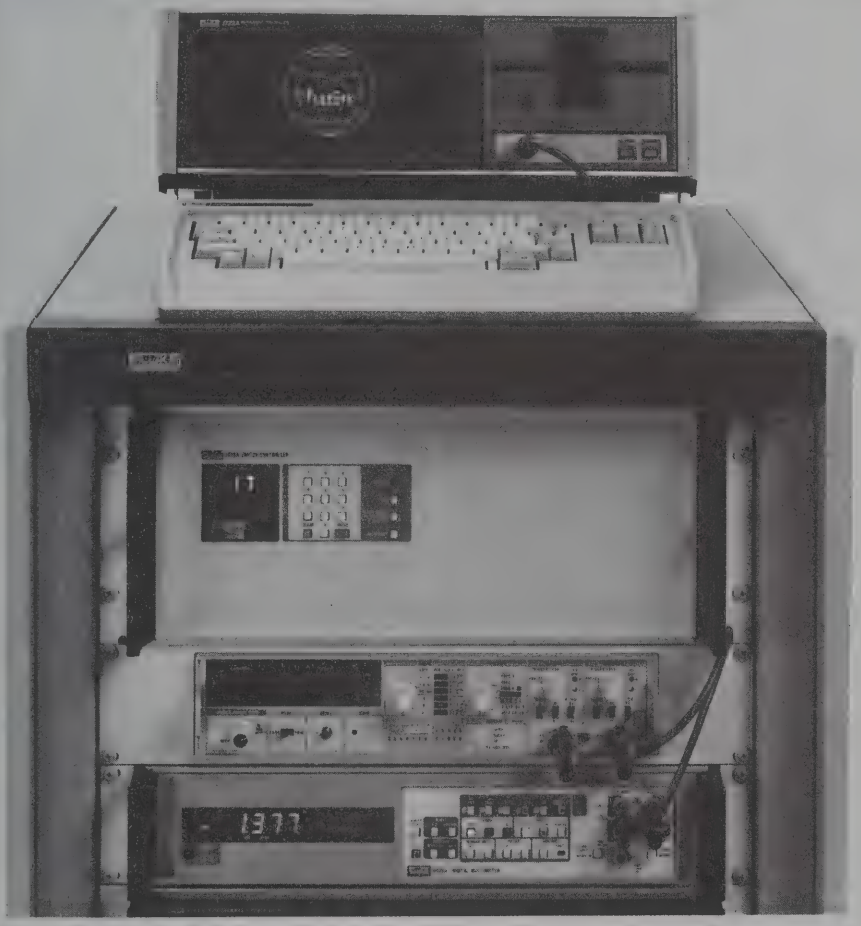
Switches		**Number of Switches**				**Switching Speed**	**Maximum Switching Power**	**Connector Type**	**U.S. Price**	**Description**
		Mode 1	**Mode 2**	**Mode 3**						
PM 2120	Universal Switch	20	10	10		10 to 20 ms Note 1	30V 200 mA	37 pin (D) female	$480	20 individual ON/OFF switches. 10 SPDT over switches.
PM 2121	Low Level Switch (3 μV Thermal Offset)	20	10	4		<10 ms Note 1	24V 500 mA	37 pin (D) female	$600	1, 2 or 4 pole switching, with guard lines protected against current transitions.
PM 2122	50Ω Coaxial Switch	4	—	—		<10 ms Note 1	24V 500 mA	BNC	$680	A VHF coaxial switch with a 50Ω impedance for DC to 500 MHz.
PM 2123	18 GHZ Coaxial Switch	5	—	—		<40 ms Note 1	15W	SMA jack	$995	Controls 5 microwave switches, one of which is mounted inside the unit.
PM 2124	Current Switch	6	—	—		(50 + 50 x n) ms n=1 to 6 Note 1	2500VA AC 300W DC	Amphenol 97 Series	$680	Allows the switching of high currents and high voltages, 10A and 250V.
PM 2125	Probe Switch Driver	4	—	—		50 ms Note 1	—	8-pole DIN female	$450	Controls four PM 2195 probe switches, each of which can select 4 probes.
PM 2195	Probe Switch	—	—	—		See PM 2125	400 MHz bandwidth	8-pole DIN male	$650	Provides four probes which are suitable for oscilloscopes, counters, timers, etc.

Digital Input/Output		**Number of Channels**				**Switching Speed**	**Maximum Voltage**	**Connector Type**	**U.S. Price**	**Description**
		Inputs	**Outputs**							
PM 2130	Digital Input/Output	2 x 4	8			<8 ms Note 1	30V rms	37 pin (D) female	$575	2x4 optically isolated inputs and 8 optically isolated outputs.
PM 2131	Digital Input	4 x 4	—			<8 ms Note 1	30V rms	37 pin (D) female	$575	4x4 optically isolated inputs, externally powered.
PM 2132	Digital Output	—	2 x 8			<8 ms Note 1	30V rms 42V peak	37 pin (D) female	$575	2x8 optically isolated outputs, protected against short circuiting & inductive loads.

Data Acquisition		**Input/Output Ranges**				**Measurements Per Second**	**Maximum Power of the Switching Relay**	**Connector Type**	**U.S. Price**	**Description**
		Voltage			**Current**					
		Range 1	**Range 2**	**Range 3**	**Range 1**					
PM 2140	Analog Input Resolution:	200 mV 10 μV	2V	20V	250 mA 10 μA	1.6 to 10	10W	37 pin (D) female	$600	A Analog-to-Digital converter with programmable High and Low limit relays.
PM 2141	Analog Output Resolution:	±2V 1 mV	±20V 10 mV	—	±20 mA 10 μA	—	—	37 pin (D) female	$695	A 12-bit Digital-to-Analog converter with two voltage and one current range.
PM 2160	Pt-100 Temperature Unit	Pt-100 RTD	—	—	—	.8 to 2	10W	37 pin (D) female	$600	An input module for Pt-100 RTDs with programmable High and Low limit relays.

Note 1: These times work out to approximately 6 per second for an average combination of slave units programmed in BASIC on a PC, using block programming mode.

FlexSys (1790A)



1790A

FlexSys ATE Workstation Software (For 1722A)

- Provides the advantages of IEEE Std. 716 ATLAS language at a fraction of the cost of other solutions
- Allows reconfiguration (changing system hardware elements) without recompiling or modifying test programs
- Touch-sensitive, menu-driven user interface means easy training and use
- Compact workstation fits on bench or in the rack
- Includes programming tools such as syntax checking, utilities for efficient debugging, and easily customized screen menus
- Integrates a wide range of ATE equipment via GPIB/IEEE-488
- High-speed compile — typical 500 ATLAS statements per minute

FlexSys is a complete ATLAS software package that runs on Fluke's powerful GPIB/IEEE-488* controller, the 1722A. For both large and small system applications, it provides the benefits of the ATLAS language at a fraction of the cost of other systems.

With FlexSys, reconfiguration is rapid and easy without recompiling or modifying test procedures or test program sets through the use of Resource Descriptions (RDs). The result is lower cost for software development.

The Resource Description, the heart of FlexSys is a data base of instrument characteristics utilized by the system at run time. RDs define the codes and formats for a given instrument as well as the accuracies, ranges, timeouts and delays. The use of RDs at run time facilitates the rapid and straightforward configuration of the ATE system. Test program set development is independent of the specific hardware elements in the ATE system.

FlexSys provides for:

- ATLAS Test Program Set (TPS) development
- Resource Description development
- ATE configuration
- Test execution in a real-time or simulated mode of operation

Test Program Set Development

A touchscreen, menu-driven interface allows the FlexSys user to develop test program sets and retain a history of inputs easily and efficiently.

A parsing editor provides both manual and automatic syntax checking during development of ATLAS test program sets.

The ATLAS Compiler prepares ATLAS test procedures for execution through:

1. Verification of ATLAS syntax, semantics.
2. Generation of executable binary files.
3. Covering or comparing signal statement requirements to corresponding require statements to verify that the defined virtual resources can meet test program requirements.
4. Cross-reference table listing the connections between instrument ports and unit under test (UUT) pins.

The Non-ATLAS procedure capability is used for the following:

1. Access to 20 predefined IEEE-488 bus drivers. The bus drivers allow direct control of 13 lines of the bus — the eight data lines and five control lines. The most common use of these drivers would be to manipulate a UUT which is controlled through the 488 interface. The drivers may also be used to control ATE functions not currently supported by IEEE ATLAS.
2. Perform user defined procedures displaying custom screen menus through a library of touchscreen menus allows full operator interaction with a running ATLAS TPS without the need for a keyboard.
3. Perform user defined procedures that utilize the pixel graphics capabilities of the 1722A. The user can create Non-ATLAS Procedures in FORTRAN, C, or Assembly language.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

FlexSys (1790A)

Resource Description Development

With FlexSys actual resources used at run time need not be predefined — a feature unique among ATE systems. Instead, real resources (station test equipment) which meet the conditions of ATLAS REQUIRE statements are specified after compilation of the ATLAS test procedures. Information contained in the Resource Description Data Base specifies the following:

- Available functions and capabilities.
- Native IEEE-488 bus codes that control the instrument.
- The data format of information returned to the controller.
- Miscellaneous information such as settling times, instrument error codes, etc.

This data is used at run time, allowing compilation to be accomplished independent of real resources. RDs for system resources may be written by the user, or may be purchased from Fluke.

System Configuration

Configuration integrates the instruments on the 488 bus into a functional ATE test station. The System Configuration process gives the user the ability to configure and reconfigure his system with minimal cost and effort by allowing the test program sets to be run without modification or recompilation after reconfiguration of the test station.

The configuration process identifies the instruments connected to the bus and creates a Resource Description Table. This table is a collection of resource descriptions, for each instrument in the test station. ATE configuration is independent of the ATLAS test program set so that the ATE configuration need not be re-established as long as the instruments on the bus do not change.

Resource assignment establishes the logical mapping of the real resources on the bus to the virtual resources specified by the ATLAS test program set to perform the following:

- Assign a real instrument resource for each virtual resource in the test program set.
- Check that the real resources on the bus do, in fact, satisfy the virtual resources specified in the ATLAS REQUIRE statements.
- Choose signal paths which are defined in the system interface RD for use at run time.

Test Execution

Test Execution provides for:

- TPS Selection
- Simulation
- Execution
- Debug Monitoring

TPS Selection

TPS Selection allows the test operator to select from available test programs. This is conveniently done using the touch-sensitive screen to page through possible selections and designate which test program to execute.

Simulation

Simulation provided to allow a test programmer to verify correct operation of test procedures and resource descriptions without actual use of the ATE system.

Test Execution

The test equipment is controlled using the programming codes extracted from a resource description to perform the operations defined by the ATLAS signal statements.

Debug Monitor

The debug monitor commands include single step execution, setting break points, enable program trace and examination of program variables. The test engineer may examine and alter system flags and the command buffers sent to the instruments. The debug monitor allows debugging to take place at the ATLAS statement level.

Documentation

Documentation is presented for both the novice and advanced users.

Product documentation includes:

- Getting Started Manual
- System Guide
- System Configuration Manual
- ATLAS Program Development Manual
- Resource Description Development Manual

The FlexSys manual set is organized in reference form, with tab dividers, indexes, section headers on each page, and a consistent readable format. The manuals are supplemented with tutorial introductions and numerous examples.

The FlexSys ATE Workstation is available in three configurations:

Model 1790A-500

ATE System Development Software: Provides all capabilities required for resource description development, station configuration, TPS development and test execution, simulation, and non-ATLAS module linkage, complete with sample RDs and test program sets.

Model 1790A-400

TPS Development Software: Provides the capabilities required for TPS development, configuration and execution (for the user who does not develop his own RDs).

Model 1790A-300

Test Execution Software: Provides all capabilities required for execution of ATLAS test program sets.

Options

1790A-301 Configuration (available only as an option for 1790A-300) (Included in -500 and -400)

This option allows for the rapid reconfiguration of hardware within the test station without recompilation of ATLAS test procedures.

Ordering Information

Models

January 1989 prices

1790A-500 ATE System Development Software	$21,950
1790A-400 TPS Development Software	18,950
1790A-300 Test Execution Software	5250
1790A-301 Configuration	250

Optional Resource Descriptions

Calibrators

1790A-RD01 RDs for Fluke DC Calibrators (5440A, 5440B, 5442A)	400
1790A-RD02 RD for Fluke 5200A AC Calibrator	200
1790A-RD03 RD for Fluke 5450A Resistance Calibrator	200

DMMs

1790A-RD21 RDs for Fluke DMMs (8502A, 8505A, 8506A)	800
1790A-RD22 RD for Fluke 8520A Digital Multimeter	400
1790A-RD23 RD for Fluke 8520A/AS-1 Digital Multimeter	600
1790A-RD24 RDs for Fluke DMMs (8840A, 8842A)	400
1790A-RD25 RDs for Hewlett-Packard DMMs (3455A, 456A)	800
1790A-RD26 RD for Hewlett-Packard 3478A DMM	400
1790A-RD27 RD for Keithly 192 Programmable DMM	400

Power Supplies, Power Meters

1790A-RD41 RDs for Fluke DC Power Supplies (4210A, 4216A, 4250A, 4265A, 4270A, 4275A)	400
1790A-RD42 RD for Hewlett-Packard 6002A DC Power Supply	400
1790A-RD43 RD for Hewlett-Packard 436A Power Meter	1000
1790A-RD44 RDs for Kepco Power Supply Programmers (SN488-031, SN488-032, SN488-121, SN488-122, SNR488-4, SNR488-8)	200

Signal Generators

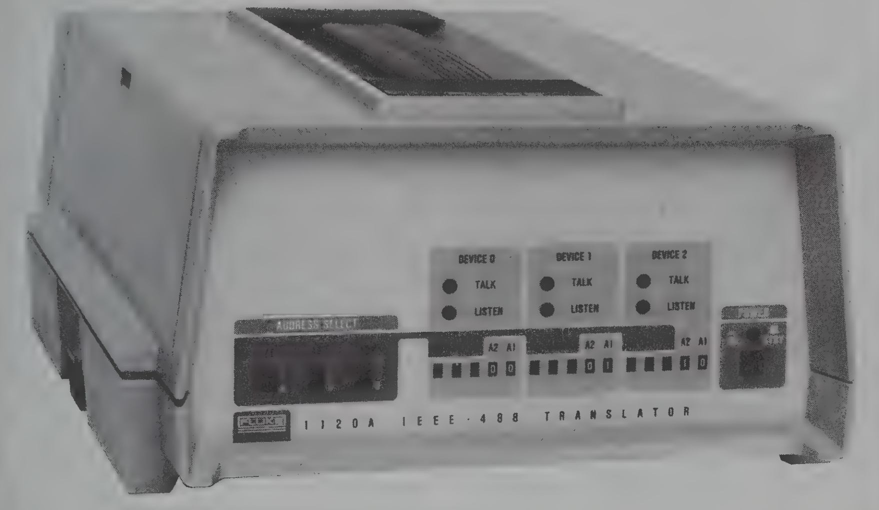
1790A-RD61 RD for Fluke 6011A Signal Generator	600
1790A-RD62 RDs for Fluke Signal Generators (6060A, 6060B)	600
1790A-RD63 RDs for Fluke Signal Generators (6070A, 6071A, 6071A/AD)	600
1790A-RD64 RDs for Hewlett-Packard 8656A Signal Generator	600

Other

1790A-RD81 RD for North Atlantic 5310 Resolver Synchro Sim	200

1120A

GPIB IEEE-488



(NSN 5811-01-202-7491) **1120A**

1120A IEEE-488 Translator

Fluke's Portable Test Instrumentation (PTI) system puts low cost instruments on the IEEE bus. The benefit is that you only pay for system capability if and when you need it. And neither size, weight, nor performance of the basic instrument is compromised for system capabilities you may not need. Instead of building interface capabilities into each low cost unit, we have designed a single instrument called the 1120A IEEE-488 Translator to do the interfacing job for you.

The 1120A is the communications link between IEEE Std 488-1978 and a variety of Fluke instruments. Operating between one or more instruments and the IEEE bus, the 1120A converts codes and signals on the bus to corresponding codes and signals compatible with the particular instrument. It passes address and control commands to an instrument or outputs data, or both, depending on the capabilities of the particular instrument being interfaced.

The 1120A is a translator for a number of Fluke instruments including universal counter/timers, communications counters, digital thermometers, frequency synthesizers, and digital ac voltmeters. Up to three instruments can be interfaced to the bus with a single 1120A, and multiple 1120As can be used in a system.

The 1120A connects instruments to the bus through an optional data output unit in the instrument and a "personality card" in the 1120A. Each personality card is individually addressable and "transparent" to other instruments. Each corresponds to a particular Fluke instrument model and is sold as an option to that instrument. The cards simply plug in to an 1120A which provides the necessary power and microprocessor-based circuits for their operation. The 1120A personality cards, accessory cables, and instrument data output units are designed to be easily assembled by the user. As your needs change, you can quickly change cards to accommodate other Fluke instruments. Many of the instruments and cables are sold as Option -521. If so numbered, they will operate directly into a Fluke 2020A (with Option -004) or 2030A Printer without an 1120A IEEE-488 Translator.

Building A System

Instruments that presently operate through the 1120A Translator to work in an IEEE-488 systems are: 2180A, 2190A, 6160B, 7220A, 7250A, 7260A, 7261A, 8920A, 8921A, and 8922A. Ordering Option -529 with most any of those instruments will get you all the things you need to connect the instrument to an 1120A Translator. However, check the catalog pages pertaining to each instrument to be sure.

For example, if you wanted to connect both a Fluke 7261A Counter and a Fluke 8920A Digital Voltmeter to other instruments on the IEEE-488 bus you could do so by ordering an 1120A Translator and checking the option descriptions for the 7261A and 8920A. You would find you need Option 892XA-529 (for the 8920A) and Option 72XXA-529 (for the 7261A).

Optional 1-meter, 2-meter, or 4-meter cables connect the 1120A Translator to other "bus instruments."

See the instrument index in the front of this catalog for a complete listing of IEEE-488 compatible instruments.

A 17-4 Bit Parallel Interface

A special circuit card may be fitted into an 1120A Translator that converts it into a general purpose translator between IEEE-488 bus systems and bit parallel data systems.

One A17-4 Card handles up to 32 digital inputs and/or outputs and up to three A17-4 cards will fit in one 1120A Translator.

Any, or all, of the 32 bits may be used as input and/or output. However, these bits must be organized in groups of four or eight. BCD, binary and hexadecimal modes may be chosen, or for status outputs any single bit may be set or reset without altering other bits in the binary or hex mode.

The A17-4 can be set to continuously monitor any designated single port (8 or 4 bits). It will then request service whenever any bit of that port, which is enabled by the SRQ mask, changes to a logic True.

The A17-4 has an output strobe line which may be used to trigger or latch external devices when the data on the output lines is valid. Similar capability is optional in the 2400B, 2280B, and the 1722A with Option -002.

For more information ask for Bulletin A0143.

Ordering Information

Model

January 1989 prices

1120A IEEE-488 Translator	$590
A17-4 Bit Parallel Interface	on req

Accessories (Also see page 485)

Y8021 1m (39.4 in) Shielded Cable	130
Y8022 2m (78.8 in) Shielded Cable	145
Y8023 4m (13 ft) Shielded Cable	155

Service & Support

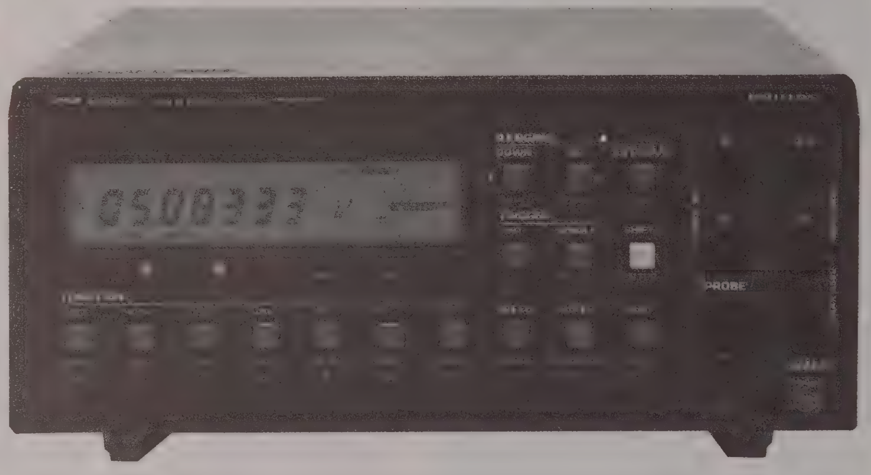
Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1120A Repair	64

PM 2534 & PM 2535



PM 2535

PM 2534 & PM 2535 GPIB Instrumentation System

- $3^1/_2$ to $6^1/_2$ digits
- 100 nV resolution
- 100 measurements
- GPIB/IEEE interface standard
- Front or rear inputs
- Scanner extension

The Philips PM 2534 and PM 2535 GPIB Instrumentation Systems cover a broad range of applications. While both instruments are suitable for a wide range of general purpose measurements, the PM 2535 offers additional advanced functions for applications demanding data gathering and fast measurement collecting and processing.

Basic Features

Both the PM 2534 and PM 2535 offer seven measurement functions, front or rear inputs and $6^1/_2$ digit guarded sensitive measurements or up to $3^1/_2$ digit high speed measurements. The units can operate in scan mode under external control via the GPIB/IEEE-488* interface.

Extra Capabilities of the PM 2535

As well as the above features, the PM 2535 has built-in data collection, advanced control facilities and calculations including Ax + B, Δ%, dBm and relative measurements. Maximum and minimum values can be stored over a time interval, and warnings can be given if specified limits are exceeded. Burst mode provides up to150 measurements/sec. Sequence programming allows repetition of the same measurement cycle; thus when combined with System 21 modules (see page380), allows the PM 2535 to act as a small data logger with no need for dedicated computer control.

Computer Control

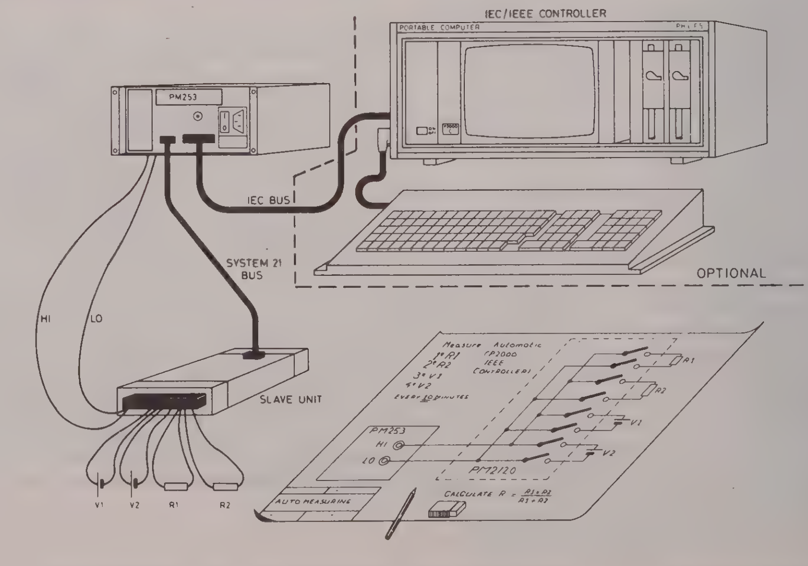
The PM 2534 and PM 2535 can be controlled via the GPIB or RS 232C interface. The PM 2535 also offers the following system capabilities: 10 functional measurement set-ups can be programmed including processing such as Ax + B, dBm or zero-set. With the SEQUENCE function these 10 functional set-ups can be made automatically and sequentially. When combined with the burst mode, the measurements made can be stored in the PM 2535 until read by the computer, thus freeing the computer to handle other routines.

Controlling System 21 Modules

Many system applications demand measurements to be made at a number of different points and require large and expensive scanners. But with the PM 2534 and PM 2535, System 21 can be added to any GPIB application to provide a modular and cost-effective solution to system switching. Both the PM 2534 and PM 2535 have a System 21 Master Unit built-in, enabling them to control any system 21 switch units.

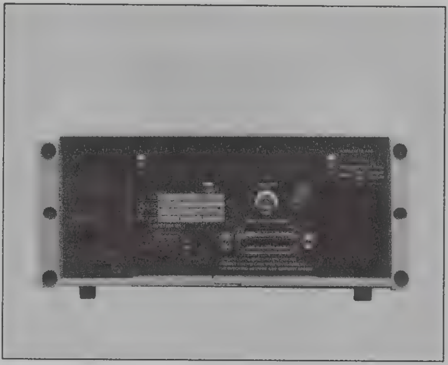
System 21 slave units connect to the internal bus connector on the rear of the PM 2534 or PM 2535 with a PM 2192 Extension Cable Set. In addition, control commands are accepted via the PM 2534 or PM 2535 GPIB interface and retransmitted to the System 21 internal bus, eliminating the need for costly interfaces, cables and power supplies.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*



Controlling System 21 without an Instrument Controller

The PM 2535 also has the capability to control System 21 slave units without the need of an instrument controller. Through the SEQUENCE function, the PM 2535 can create a 99 step program. Each step of the program is associated with one of ten functional DMM set-ups. Both the SEQUENCE program and the 10 functional DMM set-ups are stored in non-volatile memory in case of power loss. With these two functions, a small data logging system providing scaled measurements can be achieved with the PM 2535 without dedicating an instrument controller to the task.



Rear view of PM 2535 showing duplicated front panel input sockets, data bus interface and System 21 connectors.

Multidrop

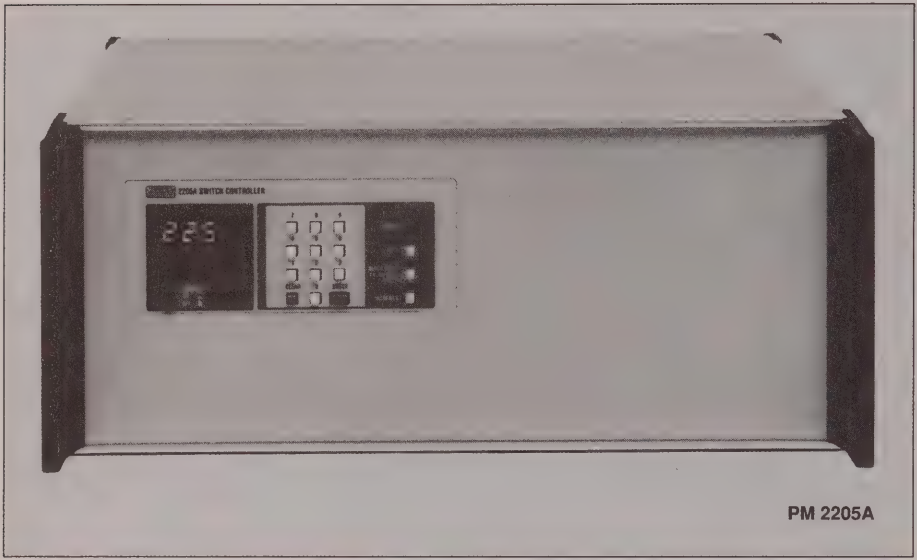
Multidrop is another possibility to operate in smaller systems. This mode allows a number of devices to be controlled by the same instrument controller. Data flow is controlled by using the SOH-ETX or STX-EOT protocol. A device is selected by SOH or STX followed by a selected character, and deselected by the same character. In this manner multiple instruments can be controlled by the RS 232C interface.

Ordering Information

For Technical Specifications and Ordering Information of the PM 2534 and PM 2535 see page 83.

2205A

GPIB IEEE-488



PM 2205A

2205A Switch Controller/Scanner

- Plug-in modules that expand the versatility of the 2205A
- Channel expansion (up to 1000)
- Matrix latching
- Low level and thermocouple scanning
- Two-wire or four-wire resistance scanning
- Actuator/Relay control
- Remote operation via GPIB/IEEE-488 interface (included)

Versatile Switching, Latching, Scanning

The microprocessor-based 2205A Switch Controller offers a wide variety of switching, scanning, and matrix-latching capabilities for applications in production testing, process monitoring, process automation, calibration, etc.

The 2205A may be operated or programmed from the front panel to perform periodic switching operations. Or it may be directed remotely in a system compatible with IEEE Std 488-1978 to perform complex switching operations.

Five Switching Options

Five kinds of switching module options are available. They plug into the 2205A mainframe and any combination of up to ten modules may be plugged in at the same time. Model 2201A or 2202A Extender Chassis allows for expansion of a system to accommodate up to 100 modules.

Three of the five types of switching options are for scanning analog signals and measuring them with a DMM. One of the three is for measuring low level signals such as the output voltage from thermocouples (-600), one is for general-purpose scanning (-300), and one is for measuring resistances using 4-wire connections (-400). Four wires are needed for precision measurements of low resistance values through long input wires. The latter option uses a pair of modules: a general-purpose module for the current-source leads and a low-level module for the voltage-sense leads.

Each module has ten reed relays and will scan ten points. The low-level reed relays switch a guard line as well as a pair of input leads.

Option -100 is an actuator module with five medium-power relays for controlling external and remote devices like indicators, actuators, alarms, power supplies, and other relays.

Option -200 is a matrix latching module that may be configured in one of three ways: either as a 1 by 8 matrix, as two 1 by 4 matrixes, or as a 2 by 4 matrix. This option features an 8 millisecond break-before-make switching speed and less than 10 microvolts of thermal offset.

Integrated Stimulus, Measurement, Control

The modularity of the 2205A makes it easy to configure switching in numerous ways. And that makes it a worthy building block for automated systems of various kinds. With the standard GPIB/IEEE-488* interface the 2205A becomes an integral part of a sophisticated system. Fluke offers numerous IEEE-488-compatible instruments including the 1722A or 1752A Instrument Controller, signal sources, power sources, calibrators, digital voltmeters, counters, thermometers, data loggers, and printers. The IEEE-488 interface supports the following subset: AH1, L2, RL1, DC1, E2.

Specifications

2205A Specifications

Control: Manual, panel-programmed scan, or via IEEE-488 Interface

Panel Controls: Select channels to be scanned, actuated, or latched. Scan rate selectable in 0.1 second increments from 0.2 seconds to 3.3 seconds per channel using behind-the-panel control

Switch-Module Slots: Ten, expandable to 100 using several 2201A (12-slot) or 2202A (10-slot) Extender Chassis

Display: 3-digit LED. Shows active channel number. Also shows assigned address (using IEEE-488 Interface) at time of power-up

Trigger Output: Rear panel BNC connector. TTL level. Adjustable delay. To trigger measurements following moments when switching occurs

Analog Output: To digital multimeter via rear panel output connector. Guarded 2-wire or guarded 4-wire connections. Common-mode voltage 170V dc or peak ac

Other Inputs and Outputs: Via module connectors included with modules

Internal Scanning Bus: Two 3-wire buses. One is common to even-numbered module slots; the other is common to odd-numbered slots. Goes to analog output. Input resistance is greater than 10 GΩ on HI or LO with respect to power line ground.

2201A Specifications

Switch-Module Slots: 12 in each 2201A. Up to 100 slots (1000 channels) per system

One or more 2201A Extender Chassis may be connected to a 2205A via a six-foot cable supplied with each 2201A. Power and control for the modules is supplied by the 2205A.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Option Specifications

Actuator Control Module (-100)

Relays: Five, SPDT
Switching Time: 20 ms*
Contact Rating: 1A maximum at up to 26V dc or 30V rms ac. 3A fuse in each common line
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -110K and -010K

Matrix Latching Module (-200)

Relays: Eight, latching, DPST with unswitched guard, break-before-make
Switching Time: 8 ms*
Rating: 40 mA maximum to 170V dc or peak ac, max
Bandwidth: Dc to 1 MHz (±0.1 dB) into 600Ω to 1 MΩ load
Thermal Offset: <10 µV
Configurations: One 2x4 matrix, two 1x4 matrixes, or one 1x8 matrix
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -210 and -009K.

General-Purpose Scanning Module (-300)

Relays: Ten, reed type, DPST with unswitched guard
Scan Rate: 125 channels per second, max*
Rating: 40 mA maximum. A 0.5A fuse in each input line
Thermal Offset: <10 µV
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Com prised of -310K and -009K.

Low-Level Scanning Module (-600)

Relays: Ten, reed type, 3PST, switched guard
Scan Rate: 80 channels per second, maximum*
Rating: 15 mA maximum to 35V peak
Reference Junction Output: 540 mV at 25°C
Thermal Offset: <1 µV
Connectors: Screw terminals on isothermal block to minimize temperature differences between terminals when scanning thermocouples. Reference junction temperature-sensing circuit on isothermal block provides automatic compensation to thermocouple output signals. Terminals are mounted on edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -610K and -008K

Four-wire Ohms (-400) (-300 plus -600)

Two modules per option, used in adjacent slots. Switch both current-source and voltage-sense connections for precision resistance measurements. Specifications for current sourcing are the same as for Option -300. Specifications for voltage sensing are the same as for Option -600, except reference junction temperature sensing circuits are not available. Comprised of -310K and -009K plus -610K and -008K. For applications requiring more than 50 four-wire ohm circuits, the 2200A-7000/AU adapter and pairs of 2201A Extender Chassis are required.

**These times are 2205A times and do not necessarily reflect system specs*

General Specifications

Temperature: 0°C to 50°C, operating; -55°C to +75°C, non-operating
Relative Humidity: ≤80% to 40°C, operating
Power: 100, 120, 220, or 240V ac ±10%, 50 to 60 Hz, selectable from rear panel. 25W maximum
Size: 17.8 cm H x 43.2 cm W x 44 cm D (7 in x 17 in x 17.4 in)
Safety: IEC 348 Protective, Class 1
Weight: 7.1 kg (15.6 lb)
Included
2205A: Manual, power cord, 3-foot Y8076 analog output cable for 8502A-16, 8505A, 8506A, 8520A, or 8860A-06 DMM
2201A: Manual, six-foot cable for connecting to 2205A
2202A: Manual, power cord but no cable

Ordering Information

Models

January 1989 prices

2205A Switch Controller including IEEE-488 Interface	$2590
2201A Extender Chassis	1900

Options

-100 Actuator Control	400
-200 Matrix Latching	400
-300 General-Purpose Scanning	400
-400 4-Wire Ohms Scanning	960
-600 Low-level Scanning	560

Accessories (Also see page 485)

2205A-008K Spare Low-Level Connector	$120
2205A-009K Spare General-Purpose Connector	120
2205A-010K Spare Actuator Connector	110
2205A-110K Spare Actuator Card	360
2205A-210K Spare Matrix Latching Card	360
2205A-310K Spare General-Purpose Scanner Card	360
2205A-610K Spare Low-Level Scanner Card	450
2200A-7000/AU Multi-Channel 4-Wire Ohms Adapter	on req
Y8021 1m Cable for IEEE-488 Bus	130
Y8022 2m Cable for IEEE-488 Bus	145
Y8023 4m Cable for IEEE-488 Bus	155
Y8004 1.5m RS-232-C Cable	110
Y8013 Trigger Output Cable, 4-foot	25
Y8076 Analog Interface Cable (included w/2205A) 3-foot	125
M07-205-600 7" Rack Adapter	110
M00-260-610 18" Rack Slides (needs M07-205-600)	130
M00-270-610 20" Rack Slides (needs M07-205-600)	130
M00-280-610 24" Rack Slides (needs M07-205-600)	130

**-7001 and -7002 both required with 2202A*

Service & Support

Warranty

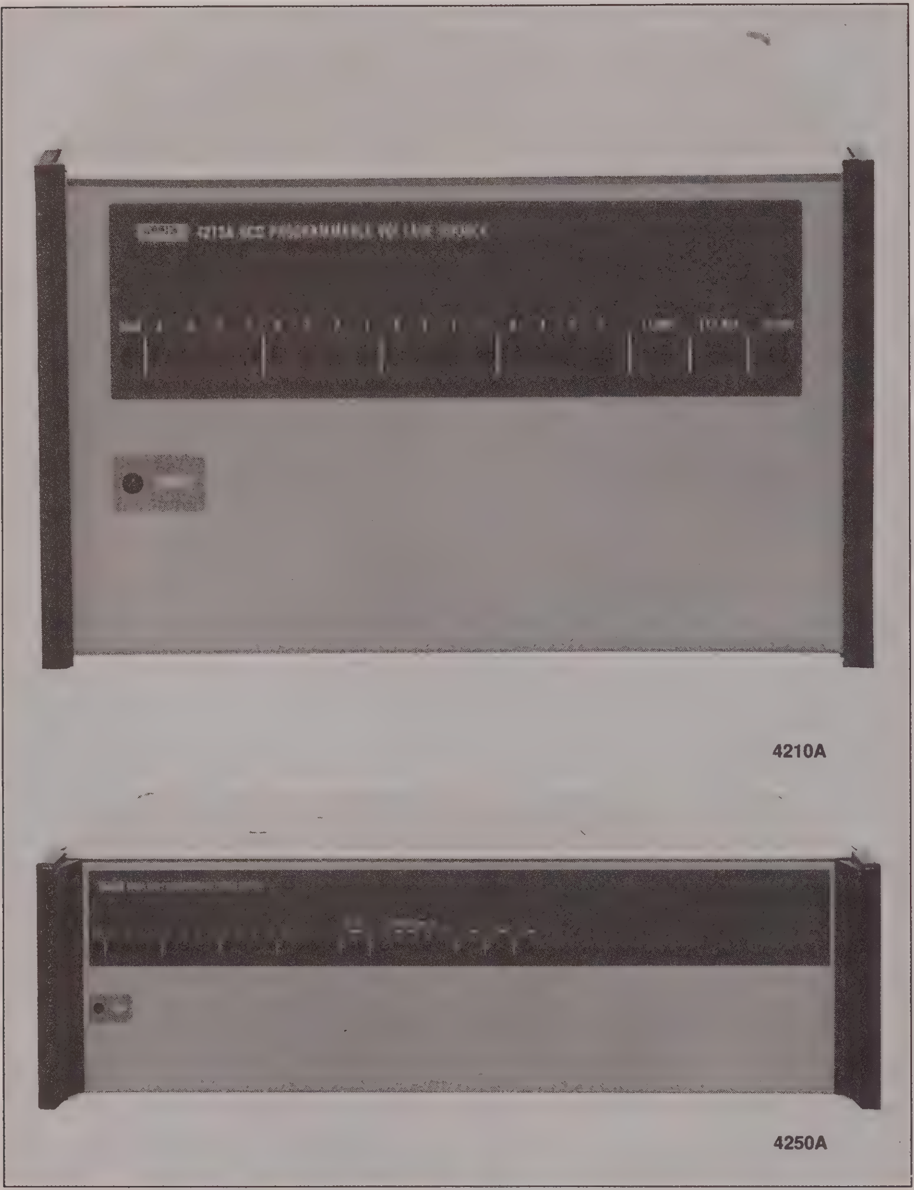
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2205A Repair (w/calibration)	420
SC1-2205A Repair (cal w/in or out data)	455
SC1-2205A Repair (cal w/in and out data)	490
SC2-2205A Cal (1 per yr recommended)	31
SC2-2205A Cal (1 per yr w/in or out data)	66
SC2-2205A Cal (1 per yr w/in & out data)	101
SC1-2201A Repair (w/calibration)	163
SC1-2201A Repair (cal w/in or out data)	198
SC1-2201A Repair (cal w/in and out data)	233
SC2-2201A Cal (1 per yr recommended)	31
SC2-2201A Cal (1 per yr w/in or out data)	66
SC2-2201A Cal (1 per yr w/in & out data)	101

4200 Series

GPIB
IEEE-488



4210A

4250A

4200 Series Power Supplies

IEEE-488 or parallel interfaces
BCD or binary 2s complement coding
Isolated digital control of ac and dc external sources
Up to 65V at 1 amp or 110V at 1/2 amp
Fully guarded
±0.01% accuracy
100 μV resolution capability
30 to 110 μs response time

The 4200 Series Programmable Power Sources are more than just precision digital-to-analog converters. They incorporate features that are not available in typical programmable power supplies: speed, accuracy, low programming noise, true current limiting, isolated control logic, output proportional to an external reference voltage.

These power sources may be operated in series or parallel, just like batteries. They will operate with up to 1000 volts between chassis ground and guard (250 volts with IEEE-488 interface). That allows you to use them as a programmable vernier for high voltage power supplies. Current sink capability, coupled with programmable current limits, allows four of the six models to be used as a dynamic load.

Isolated Control Logic Option (-01)

Isolated control logic is parallel BCD for the 4210A, 4250A, and 4270A and 14-bit or 16-bit parallel binary for the 4216A, 4265A, and 4275A and is available as Option -01. However, any of the six models may be ordered with multi-strobe logic (Option -09) or with an interface for compatibility with IEEE Std 488-1978 (Option -05).

Multi-Strobe Logic Option (-09)

Allows programming directly from any 16-bit or 18-bit program source with addressing capabilities for up to eight 4200-Series Power Sources. The power sources may be in series as well as parallel. The control lines are electrically isolated from the output.

IEEE-488 Interface Option (-05)

The IEEE-488 interface allows the user to program the following functions using command character format: Voltage, current limit, external reference, range, polarity, SRQ response on errors, operate and standby. In addition to the normal command string format of programming, the IEEE-488 interface offers a "Direct Ladder Access" mode of programming. This mode is a 4-byte transfer sequence with limited IEEE-488 error and syntax checking, but with fast output results. The repertoire is SH1, AH1, T6, L4, SR1, DC1, and DT1.

External Reference Option (-03)

Output may be ac as well as dc. And, with Option -03, you have the ability to amplify or attenuate, by digital control, either an ac or dc voltage supplied by an external source. Output polarity matches input polarity. The 3 dB bandwidth is 100 kHz for the 4210A and 4216A, and 30 kHz for the other models.

Current Limit Option (-06)

To protect devices being powered, the output current can be automatically limited to any value between 10% and 110% of maximum output cur-

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

rent in 10% steps and 1% steps to 11%. Current is automatically limited at 120% of rated output when Option -06 is not installed.

High Resolution Option (-07)

To be able to program output voltage with 10 times better resolution than normal, Option -07 may be ordered for models 4210A, 4250A, and 4270A. Option -06 cannot be installed at the same time, however.

A4200 Manual Control Unit

For bench operation and calibration the A4200 is available as an accessory. It allows the operator to manually select each control line as well as monitor flag lines available from a power source.

To view such characteristics as programming noise, settling time, rise time etc., an automatic mode is provided. When all the bits in any 8-4-2-1 decade are set, the power source will generate a staircase at the analog output which may be examined on an oscilloscope. The A4200 is not compatible with Option -09 or the IEEE-488 Interface Option (-05).

Specifications

Technical Specifications

Characteristics	1/2 Rack		Full Rack Width			
	4210A	4216A	4250A	4265A	4270A	4275A
Display	BCD	Binary	BCD	Binary	1BCD	Binary
Current Range	±100 mA	±100 mA	±1A	±1A	±0.5A	±0.5A
Option -06 Limit*	–	–	10% steps*	10% steps*	10% steps*	10% steps*
Regulation [1]	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%
Settling Time						
Within 0.1% of step	18 µs	18 µs	70 µs	70 µs	80 µs	85 µs
Within 0.01% of step	30 µs	30 µs	100 µs	100 µs	110 µs	110 µs
Low Voltage Range						
Voltage Range	±9.999	±16.383	±9.999V	±16.383V	±9.999V	±32.7675V
Resolution	1 mV	1 mV	1 mV	1 mV	1 mV	0.5 mV
W/Option -07	100 µV	–	100 µV	–	100 µV	–
90-Day Accuracy [2] ±0.01% of Output	±100 µV	±100 µV	±100 µV	±100 µV	±100 µV	±160 µV
90-Day Stability [3] ±0.003% of Output	±60 µV	±60 µV	±70 µV	±70 µV	±70 µV	±105 µV
Ripple and Noise [4]	300 µV rms	300 µV rms	500 µV rms	500 µV rms	500 µV rms	500 µV rms
Programming Noise	130 mV p-p	130 mV p-p	130 mV p-p	130 mV p-p	130 mV p-p	130 mV p-p
High Voltage Range						
Voltage Range	–	–	±65.00V	±65.53V	±99.99V	±110V
Resolution	–	–	10 mV	4 mV	10 mV	2 mV
W/Option -07	–	–	1 mV	–	1 mV	–
90- Day Accuracy [2] ±0.01% of Output	–	–	±700 µV	±300 µV	±700 µV	±530 µV
90-Day Stability [3] ±0.003% of Output	–	–	±490 µV	±210 µV	±490 µV	±370 µV
Ripple and Noise [4]	–	–	1 mV rms	1 mV rms	1.2 mV rms	1.2 mV rms
Programming Noise	–	–	260 mV p-p	260 mV p-p	260 mV p-p	260 mV p-p

**Also 1% steps to 11%. Limit at 120% of range without Option -06*

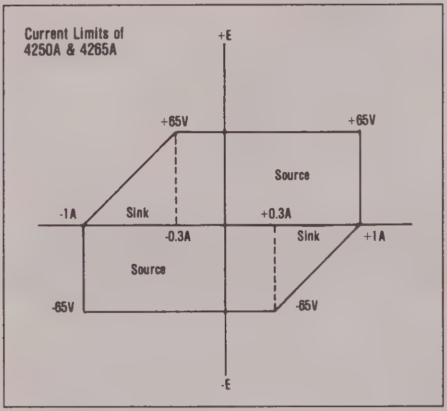
1. Percent of output, no load to full load, ±10% line change

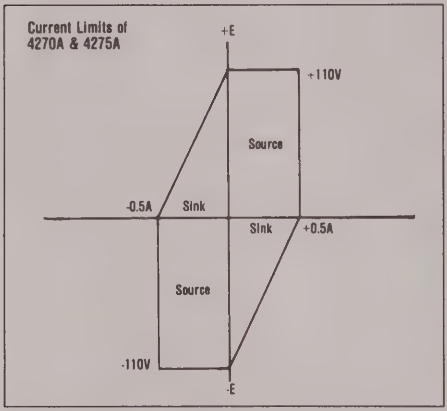
2. 15°C to 35°C

3. At constant line, load, and temperature

4. 10 Hz to 10 MHz bandwidth

4200 Series





General Specifications

Shock: 120G, 11 millisecond half-sinewave
Vibration: 14.5G, 10 Hz to 55 Hz
Altitude: ≤10,000 feet, operating; ≤50,000 non-operating
Temperature: 0°C to 50°C operating; -40°C to <75°C non-operating
Power: 115V or 230V ac ±10%, 48 Hz to 62 Hz. 4210A and 4216A 15W; 4250A and 4265A 100W; 4270A and 4275A 200W
Size
4210A and 4216A: One half 19-inch rack width, 13.3 cm H x 21.6 cm W x 40.9 cm D (5.25 in x 8.5 in x 16.13 in)
Others: Full 19-inch rack width, 13.3 cm H x 43.2 cm W x 49.7 cm D (5.25 in x 17 in x 19.56 in)
Weight
4210A and 4216A: 5.5 kg (12 lb)
Others: 15.9 kg (35 lb)
Included: Instruction manual, power cord, mating digital input cable connector, screw terminal outputs. Order Y8021, Y8022, or Y8023 cable separately for Option -05

Ordering Information

Models

January 1989 prices

4210A* Programmable Power Source, 100 mA	$3400
4216A* Programmable Power Source, 100 mA	3400
4250A* Programmable Power Source, 1 A	4850
4265A* Programmable Power Source, 1 A	4850
4270A* Programmable Power Source, 500 mA	5250
4275A* Programmable Power Source, 500 mA	5250

**Interface Option -01, -05, or -09 is also required*

Options (for above Models)*

-01 Isolated Control Logic	630
-03 External Reference	440
-05 Interface for IEEE-488 bus	700
-06 Programmable Current Limit	420
-07 1100 µV Resolution (4250A only)	650
-09 (BCD/Binary) Multi-strobe Logic	1090

**See chart below for compatibility*

Accessories (See page 485)

Rack Adapters for 4210A and 4216A	
M05-200-603 5-1/4", Dual	115
M05-203-601 5-1/4", Offset	130
M05-203-602 5-1/4", Centered	130
Rack Adapter for 4250A, 4265A, 4270A, 4275A	
M05-205-600 51/4"	95
Rack Slides for M05-200-603 or M05-205-600	
M00-260-610 18"	130
M00-270-610 20"	130
M00-280-610 24"	130
A4200 Manual Control Unit w/Cable	700
4210A-4014 PCB Extender Board	100
4270A-4303 PCB Extender Cable	205
Y8021 1m Cable, for IEEE-488 bus	130
Y8022 2m Cable, for IEEE-488 bus	145
Y8023 4m Cable, for IEEE-488 bus	155

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

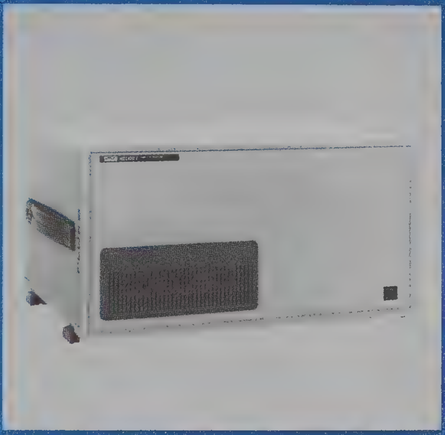
4200 Series Option Compatibility

Option	Description	4210A	4216A	4250A	4265A	4270A	4275A
42**A-01	Isolated Control Logic	1	1	1	1	1	1
42**A-03	External Reference	•	•	•	•	•	•
42**A-05	Interface for IEEE-488 Bus	1	1	1	1	1	1
42**A-06	Programmable Current Limit	–	–	2	•	2	•
42**A-07	100 Microvolt Resolution	•	–	2	–	2	–
42**A-09	Multistrobe Logic (BCD/Binary)	1	1	1	1	1	1
Other Items							
M05-205-600	Rack Adapter	–	–	•	•	•	•
M05-203-601	Rack Adapter, left or right side	•	•	–	–	–	–
M05-203-602	Rack Adapter, centered	•	•	–	–	–	–
M05-200-603	Rack Adapter, dual, left & right	•	•	–	–	–	–
M00-260-610	18-Inch Rack Slides	3	3	3	3	3	3
M00-270-610	20-Inch Rack Slides	3	3	3	3	3	3
M00-280-610	24-Inch Rack Slides	3	3	3	3	3	3

Notes: All options are customer-installable. However, add the suffix letter K if option is not to be installed at the factory. Order -07K and/or -09K through the parts department.
•Compatible option
1. -01, -05, or -09 is required. Only one may be installed in one instrument
2. Option -06 and -07 cannot be installed in the same instrument
3. Used with Rack Adapter -600 or -603
*42**A Use appropriate model number as prefix for option number*

Data Acquisition

Page 399 2280B

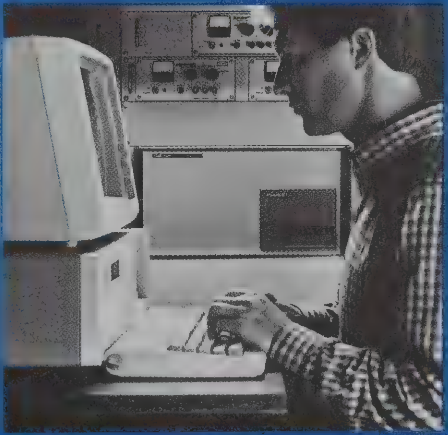


Page 405 Helios-1

Page 415 1752A

Page 419 2452MCS

Page 423 8238



Page 403 Data Acquisition Software

Whether you need a complete system or an OEM component, Fluke has a reliable measurement and control solution. Aids like industry standard communications, software tools, and PC-compatible analysis packages make our data acquisition equipment simple to set up, integrate and use.

Our 1752A Data Acquisiton System, with powerful real-time processing, is Fluke's highest-speed system for manufacturing and product testing.

Helios-I Computer Front End and application software team up for a complete PC-based system. Menu-prompted setup eliminates the need for programming. Integration with Lotus 1-2-3™ helps you present a clear picture of your test results.

The 2400B Intelligent Computer Front End conditions over two dozen signal types, and frees your host computer from time-consuming monitoring and control tasks.

The 2452MCS Measurement and Control System is Fluke's most powerful data acquistion solution for a wide variety of tests and processes. It provides the user with the computing power of the 1752A and monitoring and control of the 2400B.

The 2280 SERIES Data Loggers feature menu-prompted set-up, totally eliminating software programming. They support a full range of analog and digital options.

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Selection Guide

Measurement	2285B	2280B	1752A	2400B*	2452MCS	HELIOS-I*	PM 8238*††
Thermocouples	11 Types	11 Types	7 Types**	12 Types	12 Types	11 Types	11 Types
RTDs	All Types	All Types	100Ω Pt. 385**	All Types	All Types	All Types	100Ω Pt
Resistance	To 64K	To 64K	–	To 64K	To 64K	To 64K	To 3.9K
DC Voltage Ranges	64 mV-64V	64 mV-64V	1V-10V	100 mV-100V	100 mV-100V	64 mV-64V	30mV-30V
Max DC Resolution	1 µV	1 µV	124 µV	1 µV	1 µV	0.5 µV	1 µV
AC Voltage Ranges	250V	250V	250V**	250V	250V	250V	–
DC Current	0 to 64 mA	0 to 64 mA	0 to 65 mA	0 to 20 mA	0 to 20 mA	0 to 64 mA	–
Strain Gage	Yes	Yes	Yes**	Yes	Yes	Yes	–
BCD	Yes	Yes	Yes	Yes	Yes	Yes	–
Binary	Yes	Yes	Yes	Yes	Yes	Yes	–
Status (Contacts)	Yes	Yes	Yes	Yes	Yes	Yes	–
Counter	To 1 kHz	To 400 kHz	To 900 kHz	To 900 kHz	To 900 kHz	To 400 kHz	–
Event Totalize	Yes	Yes	Yes	Yes	Yes	Yes	–
Sequence of Events	–	–	–	Yes	Yes	–	–
Control							
Status or Alarms	0-100	0-1500	0-256	0-1024	0-1024	0-1500	0-32
Int Relays (Max)	1	1	–	0-1024	0-1024	–	32
User-Defined BCD	Yes	Yes	Yes	Yes	Yes	Yes	–
Analog Voltage	–	To ±10V	To ±10V	To ±10V	To ±10V	To ±10V	–
Analog Current	–	4-20 mA	4-20 mA	4-20 mA	4-20 mA	4-20 mA	–
Analog Resistance	–	–	–	To 102K	To 102K	–	–
PID	–	–	Yes	Yes	Yes	Yes	–
Stepper Motor	–	–	–	Yes	Yes	–	–
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**Also requires host computer such as Fluke 1722A, 1752A or IBM PC (IBM is a registered trademark of Interntional Business Machines, Inc.)*

***Using external signal conditioning*

Features

Features	2285B	2280B	1752A	2400B*	2452MCS	HELIOS-I*	PM 8238*††
Basic Accuracy (dc V)	±.005%	±.005%	±.02%	±.002%	±.002%	±.005%	±0.1%
Speed Channels/s	15	15†	1000†	25	25 (High Res) 1000 (Med Res)	16†	10
Programming Environment	Menu Prompted	Menu Prompted	BASIC FORTRAN Assembly C	Fluke Measurement & Control Language	BASIC FORTRAN Assembly Pro Gen & C	Dependent on Host	Function Keys + Six Digit Display
Operator Interface	Membrane Keypad	Membrane Keypad	Touch-Screen	Via Host	Touch-Screen	Via Host	4 Digit Display + Functional LEDs
Analog Input Channels	100	1500	128	1000	128	1500	
RS-232/IEEE-488	Opt	Opt	Std	Opt	Std	RS-232-C Std	Opt
12V dc Operation	Yes	Yes	Opt	–	Opt	Opt	–
Memory Expansion	None	None	3.0M + Bytes	None	3.0M + Bytes	–	–
Graphics	Plot	Plot	Dot Address	Via Host	Dot Address	Via Host	1000 Point Chart Recording
Permanent Data Storage	Host	Cartridge	Disk Non-Volatile RAM	Eprom Host	Disk Non-Volatile RAM	Host	Hard Copy
Built-in Printer	Yes	Yes	–	–	–	–	Yes
Battery Back-up	Program, Clock	Program, Clock	Clock	None	Clock	Definitions, Clock	Program, Clock
Software for IBM PC	Yes	Yes	–	Yes	–	Yes	Yes
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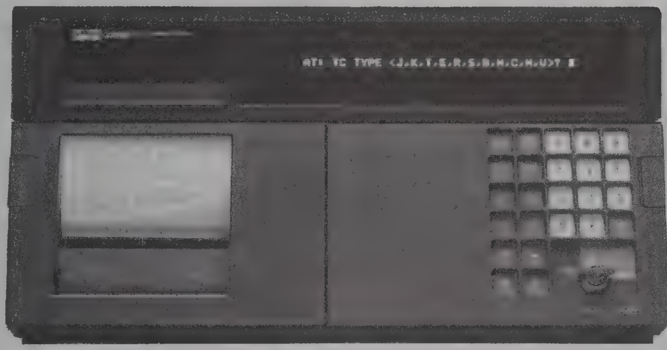
†Higher speeds possible with Multiple A/D Converters

††Specifications also applicable to KS 8238

2280 Series

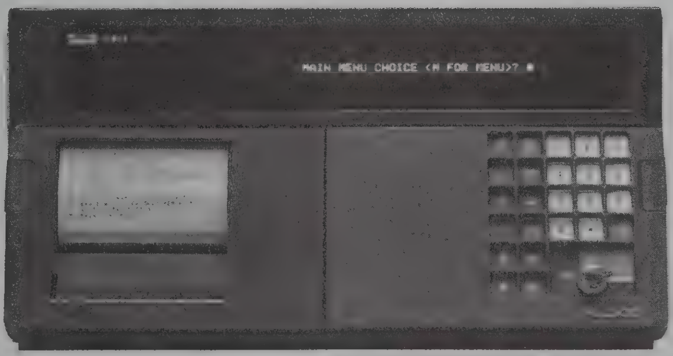
GPIB
IEEE-488



2280B

2280B Data Logging System

- Fluke's most powerful data logger
- Expandable to 1500 channels*
- Precision measurements and control
- Flexible report generation
- 12V operation for mobile or field use
- Pseudo-channels give computer power without writing software



2285B

2285B Data Logger

- Economical solution for simpler applications
- Expandable to 100 channels
- Precision measurements
- Flexible report generation
- 12V operation for mobile or field use
- Pseudo-channels give computer power without writing software

The 2280 SERIES, a family of advanced data loggers, combines high measurement accuracy, exceptional configurational flexibility, and computer-like power without requiring the user to write software. This family, composed of the 2285B Data Logger and the more powerful 2280B Data Logging System, offers solutions for demanding data acquisition and reporting problems.

The 2280B Data Logging System, Fluke's most powerful data logger, is expandable from a simple 20 channel data logger to a distributed 1500 point data acquisition system. The 2280B Data Logging System accepts all 2280 SERIES options, offers the ultimate in data logging power and flexibility.

For applications that do not require all the power or expansion capabilities of the 2280B Data Logging System, the 2285B Data Logger is a more economical solution. Expandable to 100 points, the 2285B accepts all 2280 SERIES options, except the Analog Output (-170), Counter/Totalizer (-167), Cartridge Tape (-214), and Advanced Math (-211) options.

Programming Ease

Both the 2285B and 2280B are programmed by responding to a series of prompted menus. Simple front panel responses to the displayed questions configure the 2280 SERIES to perform the required tasks. Instead of limiting the user to pre-defined functions, or requiring the development of libraries of application software, the 2280 SERIES employ pseudo-channels. An exclusive 2280 SERIES feature, pseudo- channels allow any mathematical relationship between channels, such as group averages; or between a channel and time, such as rate of change; to be described as a simple algebraic equation. With pseudo-channels, application problems that previously required the power of a computer, and an investment in software, are now possible in a stand-alone data logger.

Power to Get the Job Done

Accenting this computational power, the 2280 SERIES offer excellent documentation features. Each measurement channel, output channel or pseudo-channel can be uniquely identified with a 15 character label, clearly describing the point being logged. Adding further clarity, 6 character, user defined, engineering units for each point are a standard feature. Also standard is the ability to check every input, output or pseudo channel against alarm limits. Four high/low limits are available for each channel, and each limit can cause a user defined 40 character message describing the alarm condition to be recorded.

Report Generation

The 2280 SERIES allows its recording function to be easily tailored to the requirements of the job. Collected data, the results of calculations, or outputs can be viewed on the bright, 40 column

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**Depending on programming requirements.*

vacuum fluorescent display, or logged on the wide format 40 column internal printer. Adding further recording flexibility are two communication ports which can be configured with optional RS-232-C or GPIB/IEEE-488* interfaces. An optional DC100 magnetic tape drive is also available for the 2280B Data Logging System, allowing 500K bytes of data and/or programs to be saved on each tape. This stored data may later be downloaded to a PC using the Prologger Software Package.

For Demanding Environments

Applications that require more input or output points than can be housed in the mainframe are satisfied by using the 2281A extender chassis. These extender chassis are connected to the mainframe with a simple six twisted pair cable, and communicate via a high speed, fault tolerant, communication network. Since all communication is digital, signal integrity is assured in electrically noisy environments. Furthermore, any input or output options housed in an extender chassis have an operating range of -20°C to +70°C.

Portable Operation

Another standard feature is full operation from 12V dc power, making the 2280 SERIES a natural for mobile data acquisition. Additionally, connecting a 12V battery allows this dc operating mode to function as an uninterruptable power supply. The 2280 SERIES trickle charges the battery when on line power and bumplessly transfers to battery operation when line power fails, assuring measurement integrity for critical applications.

Specifications

2280 SERIES System

Maximum Inputs & Outputs: ≤1500 points per system (2280B); ≤100 points per system (2285B) Analog Inputs: ≤1500 channels per system (2280B), ≤100 channels per system (2285B)
Status, Binary, or BCD Inputs: ≤1500 lines per system (2280B), ≤100 lines per system (2285B)
Status Outputs: ≤1500 points per system (2280B); ≤100 points per system (2285B)
Alarm Outputs: ≤1500 points per system (2280B); ≤100 points per system (2285B)
Analog Outputs: ≤600 points per system (2280B only)
Computation Power: Besides built-in thermo couple and RTD linearizations, the 2280 SERIES will handle equations involving addition, subtraction, multiplication, division, and parentheses. Advanced Math Option (-211) (2280B only) adds square root, exponent, logarithm, trigonometric, standard deviation, interpolation tables, logic functions, equal-to, less-than, greater-than, etc.

Tasks: Up to 10 independent, prioritized scan groups
Scanning Speed: Depends on the number of A-to-D Converter Options (-161) per system and the system configuration. Scanning dc voltage inputs for alarms at full accuracy:
Up to **16** channels per second with **1** A/D Option
Up to **30** channels per second with **2** A/D Options
Up to **42** channels per second with **3** A/D Options
Up to **65** channels per second with **5** A/D Options
Temperature: 0°C to 50°C operating (2280B/2285B); -20°C to 70°C operating (2281A)
System Communications: High speed digital data transferred between 2281As and a 2280B/2285B is via noise-immune twisted wire-pairs. May be linked in star and/or daisy-chain configurations
Distance To Extender Chassis: Any 2281A may be up to 1 km away from a 2280B/2285B
Failures: System component failures are reported as an alarm. All properly operating equipment continues with normal tasks

2280 SERIES Mainframe

I/O Capacity: Six slots for input and output op tions. One of the six slots must contain an A-to-D converter option when one or more analog input options is used. Each analog input option will scan 20 channels and each status or digital input or output option will handle 20 lines. If no A-to-D converter option is needed, each 2280B/2285B will handle up to 120 points of status inputs or outputs. Two additional plug- in slots are for any combination of one or two IEEE-488 or RS-232 options
Program Memory: 32K bytes (2280B); 20K bytes (2285B). Non-volatile. Battery back-up for at least 30 days, 90 days typical. Program may also be printed using internal printer or with optional interface to external devices
Internal Printer: Uses thermosensitive paper, 110 mm (4.4 in) wide. Up to 40 alphanumeric characters per line printed from 5x7 dot matrix, 2.6 lines per cm (6.7 lines per in). Each line printed below the previous line. Will plot one to four graphs from scanned or calculated data, instead of alphanumeric characters, using distinctive symbol for each graph in any of 276 discrete positions across width of paper. Automatic paper take-up reel prevents spilling and allows withdrawal of any printed portion for review
Power: 100, 120, 220, or 240V ac ±10%, 50 or 60 Hz. Or 10.5 to 15V dc. Ac power will trickle-charge 12-volt battery for uninterrupted power. Less than 120W fully loaded
Included: Manual set, Getting Started Guide, one roll of printer paper, one pad of programming forms and power cord

2281A Extender Chassis

Capacity: Same plug-in options as 2280B/2285B
Power: Normally supplied by 2280B/2285B via 2281A-402 cable or equal. An optional built in power supply (2281A-431) may also be used and may be required for remote operation
Operating Temperature: -20°C to +70°C
Weight: 20-29 kg (45-66 lb) depending on configuration
Size: 22.23 cm H x 43.94 cm W x 66.17 cm D (9.35 in H x 17.30 in W x 26.05 in D)
Altitude: Operating: 3050 M (10,000 feet); non-operating: 12,200 M (40,000)

Options

DC 100 Tape Drive Option (-214) (2280B only)

Used to store both scanned data and data logger programs. A single tape can contain multiple files of programs and/or data as the operator chooses. The tape is formatted with a directory which may be listed on the printer.

Four data compression formats are selectable for data recorded. Storage capacity is 500K bytes which is 11,300 to 41,600 channel readings dependent upon format selection.

Recorded data may be transferred to the internal printer, peripheral devices, or a PC (See Prologger software page 403). The data transfer function permits data recorded at full speed to be transferred to a slower device such as the internal printer. The operator may transfer an entire file or part of a file based upon the time the data was recorded. For example, if a file contains data from a 24-hour test, the operator may only be interested in printing information gathered between 2:00 p.m. and 3:00 p.m. The operator enters these "start" and "stop" times and the 2280B searches for and transfers only those scans which were executed in the 2 to 3 p.m. time span.

One blank DC 100 tape cartridge is included with Option -214.

Advanced Math Option (-211) (2280B only)

Functions: Absolute value, square root, exponential, sine, cosine, tangent, arc sine, arc cosine, arc tangent, common logarithm, natural logarithm, e^x, exponentiation, integer part, maximum value, minimum value, standard deviation, elapsed time
Logical Operators: AND, OR, NOT, EXCLUSIVE OR
Relational Operators: <, ≤, >, >, =, ≠
Interpolation Tables: ≤10, user-entered. Number of points per table is limited only by system memory

High Performance A/D Converter Option (-161)

One per 2280B/2285B and 2281A required for any analog measurement inputs. ≤15 total per system

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Dynamic Range: 80,000 counts
Ranges: ±64 mV, ±512 mV, ±8V, and ±64V dc
Resolution: 1 µV on 64 mV range, 10 µV on 512 mV range, 100 µV on 8V range, 1 mV on 64V range
Common Mode Noise Rejection: ≥170 dB at 50 or 60 Hz ±0.1%; ≥160 dB at dc; 100 ohm unbalance
Normal Mode Noise Rejection: ≥60 dB at 50 or 60 Hz ±0.1%
Operating Temperature: -20°C to +70°C

2280B/2285B & 2281A Input Options

For These Inputs	Use Connector Option	With Scanner Option	Maximum Inputs Per Scanner
Thermo-couples	-175	-162**	20
DC Voltage	-176 or 175	-162**	20
DC Current	-171	-162**	20
AC & DC Voltage	-160	-162**	10 AC 10 DC
RTDs or Ohms	-177	-163**	20
RTDs, Ohms Strain	-174*	-164**	20
Status	-179	-168	20
BCD Digits	-179	-168	5
Binary	-179	-168	17 Bits & Sign
Frequency	-179	-167/AA	4
Frequency	None Req	-167	6 (2280B only)
Totalize Events	-179	-167/AA	4
Totalize Events	None Req	-167	6 (2280B only)

**A dc voltage scanner and companion connector Option (-162 and -176) are also required for each Transducer Excitation Option -164 used for RTDs, Ohms, or Strain measurements*
*** A/D Converter (-161) required in chassis*

Voltage, Thermocouple Inputs

Thermocouple and DC Scanner Option (-162)

Channels: Twenty per option. One 3-pole dry reed relay for each channel (Hi, Lo, Shield)
Ranges: 64 mV, 512 mV, 8V, and 64V, software-selectable
Input Impedance: ≥200 MΩ on 64 mV and 512 mV ranges, 10 MΩ on 8V, and 64 ranges
Thermal Offset: ≤1 µV each channel
Maximum Input Voltage: 250V dc or rms ac between Hi and Lo terminals
Maximum Common Mode Voltage: 250V dc or rms ac between Hi or Lo and ground or between two adjacent channels

Isothermal Input Connector Option (-175)

Channels: Twenty 3-wire sets of screw terminals for thermocouple or voltage input wires. Large, insulated aluminum block serves as reference junction
Maximum Measurable Voltage: 64V dc
Compatibility: Plugs onto scanner module, Option -162

Voltage Input Connector Option (-176)

Channels: Twenty 3-wire sets of screw terminals for dc voltage input wires
Maximum Measurable Voltage: 64V dc
Compatibility: Plugs onto scanner module, Option -162
DC Voltage Accuracy: ±(% of Rdg + Counts)*

Range	90 Days 15°C°C to 35°C	1 Year 15°C to 35°C	1 Year** -20°C to 70°C
64 mV	0.005% + 7	0.01% + 8	0.03% + 9
512 mV	0.005% + 3	0.01% + 4	0.03% + 5
8 mV	0.005% + 7	0.01% + 8	0.03% + 9
64V	0.009% + 3	0.02% + 4	0.05% + 5

**Total instrument accuracy using Option -162 and -176*
***A/D Converter must be in 2281A for operation to -20°C or 70°C*

Temperature Measurement Accuracy, Thermocouples

Thermocouples		Accuracy [1] [3]		
Type & Range °C	Temperature °C	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year [2] -20° to70°C
J	-100 to -25	0.45	0.5	0.8
-200 to 760	-25 to 760	0.35	0.4	0.7
K	0 to 900	0.4	0.45	0.7
-275 to 1350	900 to 1350	0.52	0.65	1.3
T	-100 to 75	0.58	0.65	1.1
-230 to 400	75 to 150	0.35	0.39	0.7
	150 to 400	0.3	0.34	0.6
E	-100 to -25	0.47	0.54	0.9
-250 to 900	-25 to 750	0.3	0.33	0.6
	750 to 900	0.33	0.4	0.8
R	250 to 450	0.9	1.0	1.3
0 to 1767	450 to 1767	0.8	0.9	1.4
S	200 to 1767	0.97	1.1	1.6
0 to 1767				
B	600 to 800	1.4	1.6	1.9
200 to 1820	800 to 1820	0.96	1.1	1.3
N [4]	-100 to 150	0.6	0.7	1.1
-200 to 400	150 to 400	0.4	0.44	0.7
C	200 to 1000	0.57	0.66	0.94
0 to 2315	1000 to 2000	0.90	1.2	2.1
	2000 to 2315	1.3	1.7	2.9
JDIN	-100 to -25	0.5	0.56	0.9
-200 to 900	-25 to 900	0.4	0.45	0.7
TDIN	0 to 200	0.48	0.53	0.8
-200 to 600	200 to 600	0.37	0.41	0.7

1Total instrument accuracy. Includes all instrument errors such as A/D errors, scanner errors, power supply warm-up, reference junction errors, conformity errors, etc.
2Total instrument accuracy using Option -162 and -175 in 2281A chassis.
3A/D Converter must be in 2281A for operation to -20°C or 70°C.
4For AWG 28 wire.

Current Input Connector Option (-171)

Channels: Twenty 2-wire pairs of screw terminals for current inputs. Typically for 4 to 20 mA or 10 to 50 mA inputs
Maximum Measurable Current: 64 mA per channel
Current-Sense Resistors: 8Ω ±0.02Ω
DC Current Accuracy: ±(0.25% of reading + 4 counts) for 90 days
Compatibility: Plugs onto scanner module, Option -162

AC Voltage Input Connector Option (-160)

Channels: Ten 2-wire sets of terminals for ac voltage and ten for dc voltage
Voltage Range for AC: 5V rms to 250V rms measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Frequency Range for AC: 45 Hz to 450 Hz
Accuracy for AC: 1% of reading ±0.1V for 90 days. Average-responding conversion; calibrated for rms value of sinewaves
Voltage Range for DC: 64V maximum measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Accuracy for DC: Same as for Option -162 with Option -176
Compatibility: Plugs onto scanner module, Option -162

RTDs & Ohms Scanner Option (-163)

A 20-channel scanner module for precision measurements of RTDs and/or resistances.
Measurement Modes: 4-wire or one of two 3-wire modes (both with lead-wire resistance compensation). One 3-wire mode eliminates reed resistance errors
Ranges: Three; 256Ω, 2048Ω and 64 kΩ (or user selectable), software programmed
Current Sources: Two; 1 mA and 32 µA (or user selectable)
Input Isolation: 250V dc or ac rms between separate scanner modules. 250V dc or ac rms between the two decades of channels within a scanner module. 250V dc or ac rms between all channels in two of the three measurement modes. 30V dc or 24V ac rms between terminals of a channel

RTDs & Ohms Connector Option (-177)

Plugs onto the Option -163 circuit card module. Contains five terminals per channel for 20 channels of RTD and resistance input wires.

RTD Specifications, Six Classes

- **A**–User-defined high resolution Platinum RTDs
- **B**–High resolution Platinum 385 DIN RTDs
- **C**–User-defined high temperature Platinum RTDs
- **D**–High temperature Platinum 385 DIN RTDs
- **E**–Ten Ohm Copper RTDs, not grounded, electrically insulated
- **F**–Ten Ohm Copper RTDs, grounded (special, consult factory)

RTD Class	Temperature	System		
		Resolution	Accuracy*	Repeatability*
A	-200 to +150°C	0.006°C	0.1°C**	0.04°C**
	+150 to +420°C	0.006°C	0.15°C**	0.04°C**
B	-200 to +150°C	0.006°C	0.10°C**	0.04°C**
	+150 to +420°C	0.006°C	0.15°C**	0.04°C**
C	-200 to +600°C	0.05°C	0.27°C***	0.16°C***
D	-200 to +600°C	0.05°C	0.28°C***	0.16°C***
E	-75 to +150°C	0.06°C	0.3°C**	0.17°C**
F	-75 to +150°C	0.06°C	1.25°C**	0.3°C**

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*
***RTD Temperature ≤150°C*
****RTD Temperature ≤600°C*

Note: Classes A and C allow the user to perform an ice point initialization and improve total system accuracy to be the sum of repeatability plus 0.03°C for 390 and 392 RTDs. The same procedure for a 385 DIN RTD yields total system accuracy to be the sum of repeatability plus 0.03°C plus the RTD probe conformity error.

Ohms Specifications Option (-163,-177)

Range	Resolution	±(% of Rdg + Ω)	
		Accuracy	Repeatability
256Ω	2.4 mΩ	0.017% + 5.7 mΩ	0.0065% + 5.7 mΩ
2048Ω	19 mΩ	0.017% ±38 mΩ	0.0060% ±38 mΩ
64 kΩ	0.6 mΩ	0.06% ±1.22Ω	0.0075% ±1.22Ω

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

RTDs, Ohms, & Strain Excitation Option (-164)

Five constant current sources for measuring RTDs and/or resistances and a constant voltage source for measuring strain. Channels are configurable in groups of four for either voltage or current excitation. These current sources are factory configured for 1 mA output and are user-modifiable for other ranges. The voltage supply is switch-selectable for either 2V or 4V and can supply up to 250 mA. A bridge completion network is provided for 1/2- and 1/4-bridge strain gages. Requires Connector Option -174. Option -174 and -164 plug together and occupy one I/O slot in Helios-I or 2281A, usually adjacent to the corresponding Scanner Option -162, which is also required.

RTDs, Ohms, & Strain Connector Option (-174)

Channels: Twenty 5-wire sets of screw terminals for connections to RTDs or strain gages. Terminals also provide access to the bridge completion network of Option -164
Compatibility: Plugs onto excitation module, Option -164

Ohms Mode Specifications Option (-164, -174)

Max Resistance	Accuracy* ±(% of Rdg + mΩ)	Resolution	Excitation Current
64Ω	0.02% + 7	1 mΩ	1 mA
512Ω	0.02% + 30	10 mΩ	1 mA
Other ranges that may be set by user			
5.12 kΩ	Depends on user's resistor	0.1Ω	0.1 mA
51.2 kÛ		1Ω	0.01 mA

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

RTD Mode Specifications Option (-164, -174)

RTD channel definitions allow you to tailor the instrument to the known characteristics of your probe with a conformity error less than 0.05°C
Resolution: 0.02°C
Temperature Measurement Accuracy*

RTD Type & Range	Maximum Instrument Error
100Ω Platinum RTDs	
-200°C to +200°C	0.1°C
200°C to 600°C	0.15°C
10Ω Copper RTDs	
-75°C to +150°C	1.0°C

**Total Instrument Accuracy, 13°C to 33°C for 90 days.*

Repeatability: ±0.08°C for Platinum RTDs, ±0.2°C for Copper RTDs
Temperature Coefficient: ±10 ppm/°C

Strain Mode Specifications Option (-164, -174)

Full-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges with 2V supply or ten 120Ω bridges with 4V supply
Resolution: 0.25 microstrain
Total System Accuracy: ±(0.05% of rdg + 2 microstrain)*
Temperature Coefficient: ±10 ppm/°C
1/2-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 13 microstrain)*
Temperature Coefficient: ±15 ppm/°C
1/4-Bridge Strain
Capacity: Twenty bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 25 microstrain)*
Temperature Coefficient: ±20 ppm/°C
**20°C to 30°C for 90 days*

Frequency Measurement and Event Totalization (-167) (2280B only)

Channels: Six
Functions: Event counting and frequency measurement, selectable per channel pair

Inputs
Signal Types: TTL, CMOS, contacts, analog waveforms
Adjustments: Threshold, deadband, and debouncing
Isolation: Each group of six channels isolated from ground
Frequency Measurement: 400 kHz maximum frequency, 0.001% resolution

Event Counting
Maximum Counts: 8,388,607
Counting Rate: DC to 400 kHz
Operation: Count is reset after each scan
Connector: Screw terminal connector supplied

Frequency Measurement and Event Totalization (-167/AA)

Channels: Four
Functions: Event counting and frequency, selectable by channel

Inputs
Signal Types: TTL or contacts
Adjustments: None
Isolation: Each group of four channels isolated from ground
Frequency Measurement: 1000 kHz maximum frequency, 1 Hz resolution

Event Counting
Maximum Counts: 65,534
Operation: Count is reset after each scan. Pseudo channels are used for count accumulation
Counting Rate: DC to 1000 kHz
Connector: Uses -179 Digital/Status Input Connector (not supplied)

Digital & Status Inputs & Outputs

Digital Input/Output Module Option (-168)

For controlling up to 20 input or output lines. Handles either 20 status inputs, 5 groups of 4-wire BCD digit inputs, or one 17-bit binary number (and sign). Or handles 20 status outputs. Inputs: Zero volts or contact closures for low, +6 volts maximum for high
Common Mode Voltage: 30V rms ac or dc, maximum
Outputs: Open collector NPN transistors, diode clamped, 28V maximum, 100 mA at 1V
Compatibility: Requires connector Option -179 for inputs or connector Option -169 for outputs

Digital/Status Input Connector Option (-179)

Channels: Twenty 2-wire pairs of terminals for Option -168 plus terminals to select BCD and binary clocking format

Status Output Connector Option (-169)

Channels: Twenty 2-wire pairs of terminals for Option -168. Also terminal provided for clamping diodes when used to drive relays

Analog Output

Analog Output Option (-170) (2280B only)

Outputs: Four per module. Each output has a selectable choice of mode: -5V to +5V, 0V to +10V, or 4 to 20 mA
Resolution: 2.44 mV in voltage range, 3.9 µA in current range
Accuracy: ±0.1% of range for 90 days, 15°C to 35°C (
Isolation: Each group of four channels isolated from ground
Compliance Current: 5 mA in voltage mode
Compliance Voltage: 10V in current mode
Temperature Range: -20°C to +70°C, operating in 2281A
Connector: Included with option

Other 2280 SERIES Options

RS-232-C Interface Option (-341)

Data may be output via the RS-232-C interface at 110 to 19,200 baud, selectable from the front panel. May be configured to operatoe on a 20 mA current loop and can serve as the 20 mA current source.

Other RS-232-C parameters selected via the front panel include: Data compression format, channel readings per line, start of data sequence, end of data dwquence, line termination sequence, and parity.

Acts as a erminal (DTE) or, with an included adapter, as a modem (DCE), or both (with two Options).
Baud: 110, 300, 600, 1200, 4800, 9600, or 19,200
Parity: Odd, even, or neither

Option -341 includes a Y1707 2-meter cable and a Y1705 null modem cable.

IEEE-488 Interface Option (-342)

Operates as either a talker only, or talker/listener. Easy-to-read thumbwheel switches are used to set the IEEE-488 address and are accesible from the rear panel. Data output parameters selected from the front panel include data compression format and the number of channel readings per line.
Repertoire in Port A: SH1, AH1, T5, L4, SR1, RL1, DC1, E2
Repertoire in Port B: SH1, AH1, T5, L4, SR1 and E2

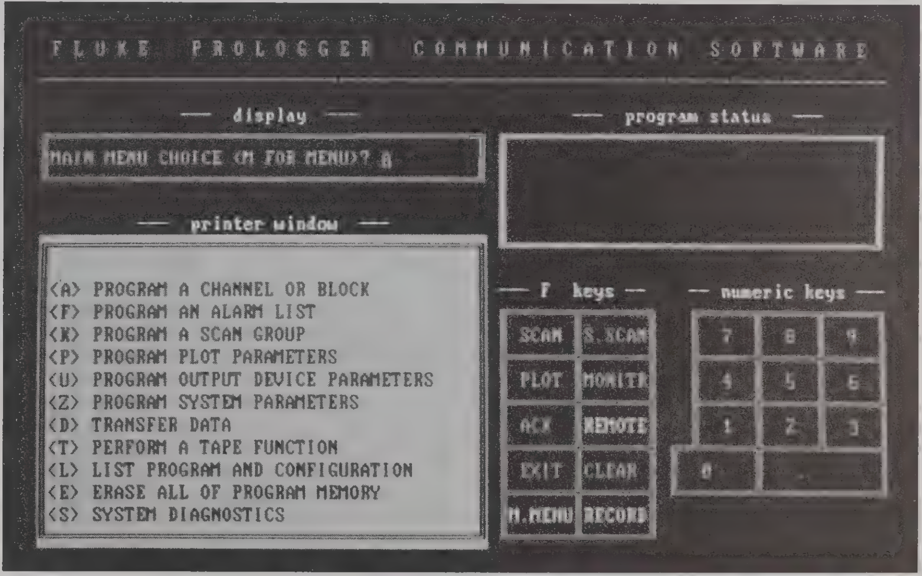
Order Y8021, Y8022, or Y8023 IEEE-488 cables separately.

2281A Power Supply Option (-431)

Although power for a 2281A is normally supplied by a 2280B/2285B via a2281A-402 Cable, a built in power supply Option (2281A-431) is available and is required when the distance to a 2281A and/or the current drain of the 2281A is heavy because of the number of options installed. The 2281A-431 power supply will operate on ac power or a 12V or 24V dc supply, either of which will trickle charge a 12V battery for battery. backup in the event of a power failure. Ask your Fluke Sales Office or Representative for Configuraqtion Form F605 to determine what options may be installed in a 2281A at what distances without Option 2281A-431.
Operating Temperature: -20°C to + 70°C

2280 SERIES Accessory Descriptions

Y2042: Package of five DC 100 tape catridges certified for use with Tape Drive Unit (Option -214)
Y2044: Rack Slide Kit for mounting 2280 SERIES or 2281A in a standard 42 cm (19 inch) rack with 61 cm (24 inch) depth. Contains all necessary hardware including a Y2045. Height is 22.2 cm (8.75 in).
Y2045: A rack mounting kit for 2280 SERIES or 2281A. Does not include rack slides. Fits standard 42 cm (19 inch) rack with 61 cm (24 inch) depth. Height is 22.2 cm (8.75 in).
Y2046: Package of ten rolls of thermal print paper for 2280B/2285B's printer/plotter. Capacity is 4000 lines of print, 12,000 channel readings using compressed mode.
Y2047: Three-connector device needed for "star" configurations.
A22-300: A heavy-duty transist case constructed from high-density polyethylene specifically for the 2280B/2285B. Foam Padding, cut to conform to the 2280A/2285B mainframe, insultates the data logger from shock encountered in shipping. Dimensions: 30.5 cm H x 64 cm W x 76.8 cm D (12 in x 25.1 in x 30.1 in).


FLUKE PROLOGGER COMMUNICATION SOFTWARE

MAIN MENU CHOICE <M FOR MENU>? A
— display —
— program status —
— printer window —
<A> PROGRAM A CHANNEL OR BLOCK
<F> PROGRAM AN ALARM LIST
<K> PROGRAM A SCAN GROUP
<P> PROGRAM PLOT PARAMETERS
<U> PROGRAM OUTPUT DEVICE PARAMETERS
<Z> PROGRAM SYSTEM PARAMETERS
<D> TRANSFER DATA
<T> PERFORM A TAPE FUNCTION
<L> LIST PROGRAM AND CONFIGURATION
<E> ERASE ALL OF PROGRAM MEMORY
<S> SYSTEM DIAGNOSTICS
— F keys —
SCAN
S.SCAN
PLOT
MONITR
ACK
REMOTE
EXIT
CLEAR
M.MENU
RECORD
— numeric keys —
7
8
9
4
5
6
1
2
3
0
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S2280 ProLogger Software

- For use with an IBM®-PC and the Fluke 2280 SERIES Data Loggers
- Accommodates full operation of the 2280B or 2285B from the IBM®-PC, XT, AT or compatibles
- Transfers data from the 2280 SERIES to disk in Lotus 1-2-3™ format

ProLogger Software is a tool which links the IBM-PC, XT, or AT with a Fluke 2280 SERIES Data Logger ot form a powerful data collection and analysis system. This package emulates the 2280 SERIES' front panel on the screen of the IBM,® and allows the user to program the data logger thgough the same menu prompting that is available on the 2280 SERIES itself. Other utilities allow the user to transfer data to a disk in Lotus 1-2-3™ format or ASCII, upload data from the 2280B;s option -214 Cartridge Tape Drive, download programs from disk on the IBM®-PC to the 2280 SERIES, and perform any other functions that can be accomplished from the 2280 SERIES' front panel.

The IBM®-PC must have a serial interface, graphics card, and MS-DOS 2.1 or higher. A color monitor is not a necessity, but will enhance the appearance of ProLogger. The IBM-PC needs 128k of Imemory, however. Lotus1-2-3™ will require additional memory. The 2280 SERIES Data Logger must have -341 RS-232-C Interface Option.

Ordering Information

Models

January 1989 prices

2280B Data Logging System	$7500
2285B Data Logger	5500
2281A Extender Chassis (1m Cable included)	850

Options

2280A-160 AC & DC Input Connector	295
2280A-161 High Performance A/D Converter	800
2280A-162 Thermocouple & DC Voltage Scanner	650
2280A-163 RTD & Ohms Scanner	995
2280A-164 RTD, Ohms, Strain Excitation	690
2280B-167 Counter/Totalizer, 6 Channel	950
2280A-167/AA Counter/Totalizer, 4 Channel	on req.
2280A-168 Digital or Status Input/Output	720
2280A-169 Status Output Connector	120
2280A-170 Analog Output	995
2280A-171 Current Input Connector	200
2280A-174 Transducer Excitation Connector	395
2280A-175 Isothermal Input Connector	$180
2280A-176 DC Voltage Input Connector	100
2280A-177 RTD, Ohms, Connector	210
2280A-179 Digital/Status Input Connector	100
2280A-211* Advanced Math Processor	1250
2280A-214* DC 100 Tape Drive Unit	1900
2280A-341 RS-232 Interface	990
2280A-342 IEEE-488 Interface	990
2280A-402 Connecting Cable (per meter)	5
2281A-403 Connectors for Option -402	95
2281A-431 Power Supply for 2281A	530

**Factory of Service Center installation only. Others user-installable*

Accessories (Also see page 485)

Y2042 Pack of 5 DC 100 Cartridges	130
Y2044 Rack Slide Kit and Rack Mount Kit	195
Y2045 Rack Mount Kit	150
Y2046 Rack of 10 Rolls Printer Paper	50
Y2047 Extender Chassis Multi-Connector	75
A22-300 Transit Case for 2280A	on req.
S2280 ProLogger Software	295

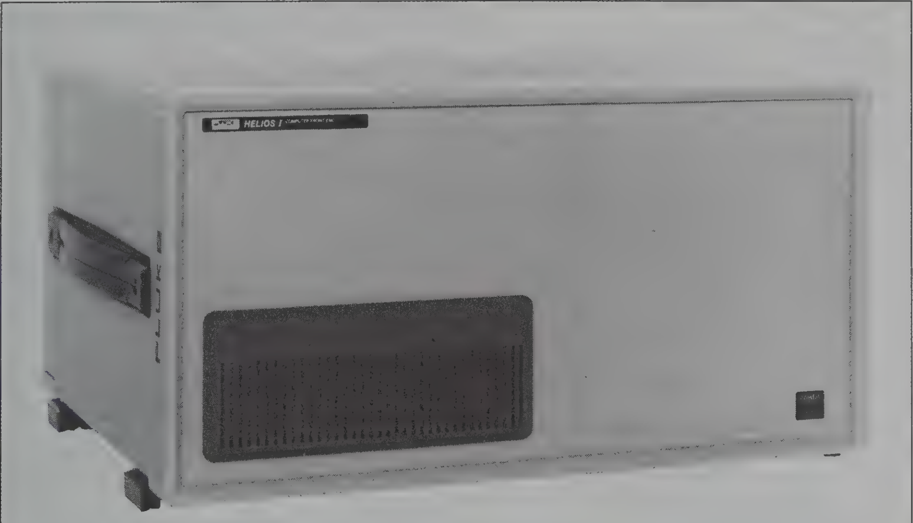
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2280B Repair (w/calibration)	$555
SC1-2280B Repair (cal w/in or out data)	590
SC1-2280B Repair (cal w/in and out data)	625
SC2-2280B Cal (1 per yr recommended)	126
SC2-2280B Cal (1 per yr w/in or out data)	161
SC2-2280B Cal (1 per yr w/in & out data)	196
SC1-2285B Repair (w/calibration)	526
SC1-2285B Repair (cal w/in or out data)	561
SC1-2285B Repair (cal w/in and out data)	596
SC2-2285B Cal (1 per yr recommended)	94
SC2-2285B Cal (1 per yr w/in or out data)	129
SC2-2285B Cal (1 per yr w/in & out data)	164
SC1-2281A Repair (w/calibration)	226
SC1-2281A Repair (cal w/in or out data)	261
SC1-2281A Repair (cal w/in and out data)	296
SC2-2281A Cal (1 per yr recommended)	94
SC2-2281A Cal (1 per yr w/in or out data)	129
SC2-2281A Cal (1 per yr w/in & out data)	164



Helios-I

Helios-I Computer Front End

- Wide range of measurement and control options
- Eliminates hardware integration problems
- Simple and powerful commands
- Application software available for a complete system
- Ruggedized dc powered version for mobile testing

Performance

You can use Helios-I to add high performance measurement capability to any of your computers, from lap-top to mainframe. Helios-I uses the same data acquisition and control options as the Fluke 2280 Series. These options have been proven in thousands of applications world-wide.

Helios-I gives your computer the power to read:

- Voltage
- Frequency
- Temperature
- Flow
- Strain
- Pressure
- Speed
- Many, many more...

The high performance Analog to Digital Converter, in conjunction with data conversion capabilities built into Helios-I, means unsurpassed resolution, repeatability and accuracy in thermocouple, RTD and strain gage measurements.

These proprietary algorithms are both highly efficient and very accurate. They are optimized for Helios-I hardware giving performance that would be hard to match if host computer routines were required.

Independent Operation

The Scan/Alarm Option (2289A-201) adds autonomous capability to Helios-I. Scan/Alarm allows routine data acquisition tasks to be performed by Helios-I, reducing the load on the host comuter and the communications link. This results in a more efficient data acquisition system for remote applications or anytime it is useful to partition tasks between the host computer and the data acquisition front end.

With the Scan/Alarm Option Helios-I will scan measurement points and store up to 18,000 readings for later access by the computer. The Scan/Alarm Option also adds limit checking, alarm output, and alarm acknowledge.

Additionally, SCAN/Alarm provides a second RS-232C port for use with a local peripheral such as a printer, terminal, or mass storage device. Data sent to this port may be sent continuously, on time interval, or only on alarm.

Hardware Configuration

You can configure Helios-I to tailor it to your exact needs. One Helios-I mainframe can house up to 6 I/O modules, each with 20 channels. Communication with the I/O modules is by means of a high speed serial link.

A wide range of I/O modules is available. Several are multifunctional, providing configuration flexibility and cost savings when an application requires a range of input and output types.

Extended Systems

Remote expansion chassis are available to bring the total configuration to 1500 channels. The distance between an extender chassis and the mainframe may be up to 1200 meters. Connections may be made in daisy chain, star and maze configurations so that cable routing can easily be adapted to the physical layout of your facility.

Multiple Helios-I mainframes may be arranged in a multidrop configuration. This allows you to address up to 10 Helios-I units on a serial link.

Application Software

CIMPAC Software (2289A-902)

Fluke and Action Instruments have joined efforts in producing system combining CIMPAC DataAcquisition and Control software and Helios-I. the resulting system allows monitoring, recording, and controlling of factory installations or processes from an IBM PC/XT/AT or compatible without the need for programming. All system functions are configured through an easy-to-use menu system accessed through one-touch function keys.

GRAPHICS: CIMPAC has extensive EGA graphics capabilities for creation of pictorial presentations to simplify operator interpretation of data. The pictures may be animated with movement and color changes tied to real time operating variable. So, for example, changes in temperature or alarm level transitions can be clearly communicated to the user.

SPQ/SQC: CIMPAC allows users to monitor and control changing tolerance parameters in real time. Special statistical registers allow CIMPAC users to conveniently store point readings and access standard deviation and averaging data for graphical display, logging, or process control.

NETWORKING: COMPAC may be run on a single PC or networked to up to eight nodes (pc's) via a simple twisted pair RS-485 communications link running at 1 megabit per second. In this real-time network, each node broadcasts its own point readings to the other stations so that users may monitor and control any point from any node, as if all stations were one. Capability is avaiable for easily uploading information to a supervisory micro or mini computer outside the network.

LabTech Notebook Software (S2290)

Fluke and Laboratory Technologies Corp. have teamed up to create a complete system for data acquisition. LABTECH Note book® transforms the IBM® PC, XT or AT and compatibles along with Helios-I into a powerful data acquisition, analysis and real-time display system and no programming is required.

Data generated using Helios-I and LABTECH Notebook® is recorded in formats compatible with major analysis, spreadsheet and database programs. These include LOTUS 1-2-3,® Symphony,® RS/1® and NWAStatpak.®

A menu driven format makes the operator interface easy to learn and to use. Complicated procedures can be reduced to single button

Helios-I (2289A)

operations. The result for you is fast system setup and increased efficiency in operation. Once the measurement and control activities are defined they can be stored on disk for easy recall.

Data acquisition can be started immediately or triggered externally. Data can be time stamped with either time of day or relative time.

LABTECH Notebook® allows other PC programs to be run concurrently. LABTECH Notebook® can perform data acquisition and control in the background while another program operates in the foreground. Your efficiency is increased considerably especially during long tests.

Helios Toolbox for BASIC Programmers (2289A-901)

Helios Toolbox is intended for the data acquisition system builder. It is a set of subroutines designed to provide building blocks for a complete system software package. By providing fully debugged and tested routines of common, and some not so common, system software tasks, software costs can be drastically reduced. The primary purpose of Helios Toolbox is to handle all communications between the host computer and Helios-I. To accomplish this Helios Toolbox provides routines to:

- Establish the communication channel.
- Define the Helios-I hardware configuration.
- Scan measurement points and read individual channels.
- Set status and analog outputs.
- Utilities that translate error codes, clear communication buffers, control Helios-I self tests.
- Log data directly into Lotus 1-2-3 worksheet file

Sources are provided for translation or user modification.

Prologger_HCL

Prologger_HCL is a communications utility for the IBM Personal Computer and the Fluke Helios Computer Front End. This software tool establishes serial communication with Helios-I and links Helios-I and the IBM to provide data acquisition capability for the IBM. Extensive use of IBM function keys provide an easy to use package.

This software package provides an environment in which you can record data from Helios-I in LOTUS 1-2-3 format, log data to a printer, create and save definitions and Macros on disk, graph in real time a selected Helios-I parameter and remotely control Helios-I.

Prologger_HCL includes a diskette and manual. Prologger_HCL is compatible with MS-DOS™ version 2.1 and above.

Helios-I is a trademark of John Fluke Mfg. Co., Inc. LABTECH is a registered trademark of Laboratory Technologies Corporation; IBM is a registered trademark of International Business Machine Corporation; Lotus 1-2-3 and Symphony are trademarks of Lotus Development Corporation; RS/1 is a trademark of BBN Software Products Company; NWAStatpak is a trademark of Northwest Analytical, Inc.

Command Set

If you desire to configure Helios-I with your own host computer software, Helios-I provides an environment that makes this interaction easy to create.

The Helios-I Operating System (HOS) resides in ROM together with the Helios-I Command Line Interpreter (HCLI). HOS takes care of task scheduling and contains driver software to control the functioning of the hardware. HCLI analyses the commands and translates them into appropriate actions.

Only six types of commands are necessary to control a standard Helios-I. Each has various parameters to change the scope of operation giving a command set that is conceptually easy yet powerful.

ASSIGNMENT: Assigns a value to a system variable or output channel.

DEFINITION: Identifies the type of sensors connected to Helios-I and if desired interpolation tables for each sensor.

LIST: Returns to the host computer channel definitions and user defined interpolation tables and errors detected by Helios.

RESET: Resets system or specified channels to power up state.

SEND: Returns data to host computer.

TEST: Tests all or part of the system and reports any detected problems.

DC Powered Helios-I (2289A/AA)

The 2289A/AA is a special ruggedized version of Helios-I designed for mobile testing and remote data gathering. It is powered from either a 12 or 24Vdc supply (8 - 18 or 21 - 28 Vdc respectively) and has an extended operating temperature range to +70 degrees C.

Specifications

Helios-I Mainframe (2289A)

The Helios-I mainframe is a cardcage unit that includes a CPU, power supply, RS-232 and RS-422 interfaces.

Controller

CPU: TMS-9995, 16 bit, 12 MHz clockrate
Memory: 40K bytes ROM, 72K bytes non-volatile RAM
Clock/Calendar: Accuracy 0.003% or 2.6 seconds/day at 25°C; battery backed
Battery Back-Up: 90 days typical, 30 days minimum
Interface: On-board command interpreter for high level instructions

Interfaces

Type: RS-232 or RS-422; asynchronous; selectable baud rate, parity, character bits and stop bits
Protocol: XON/XOFF or none; terminal or computer mode
RS-232: Compatible with auto-answer, full duplex modems; automatic hang-up
RS-422: Allows operation at extended distances from the host computer; allows point to point or multidrop configurations
Capacity: Six slots for input and output options. One of the six slots must contain an A to D Converter option when one or more analog input options is used. Each analog input option accomodates 20 channels so that up to 100 channels per chassis is available. Each digital I/O option accomodates 20 channels so that up to 120 channels per chassis is available.
Power: 90-132V ac or 180-264V ac; 47-440 Hz; less than 40W
EMI and RFI Emissions: Tested to FCC part 15, Subpart J, Class A; VDE 0871, Class B
Operating Temperature: 0°C to 50°C
Storage Temperature: -40°C to 70°C
Relative Humidity: (without condensation) below 25°C, <95%; 25°C to 40°C, <75%; 40°C to 50°C, <45%
Altitude: 12 km (40,000 ft), non-operating; 3 km (10,000 ft), operating
Shock and Vibration: Meets MIL-T-28800C, Class 5, Style F Standard
Weight: 8.5 kg (18.7 lb) without options
Size: 23.8 cm H x 43.9 cm W x 35.9 cm D (9.35 in H x 17.3 in W x 14.13 in D), (8.75 in H without feet)

2281A Extender Chassis

Capacity: Same as mainframe. Multiple extender chassis allow up to 1500 channels.
Power: Normally supplied by Helios-I via 2281A-402 cable or equal. An optional built-in power supply, 2281A-431, may also be used and may be required for some configurations.
Operating Temperature: -20°C to +70°C

Options

Scan/Alarm Option (-201)

Scanning
Number of Groups: 4
Trigger Mode: Time interval
Data Buffers
Number of Buffers: 4
Size: User defined
Format: Each scan record includes time stamp and channel status
Limit Checking
Number: 4 per channel, two high and two low
Alarm Hysteresis: User selected
Master Alarm Annunciation: Visual and audible
Master Alarm Acknowledge: Edge sensitive input for external pushbutton
Individual Alarm Output: Up to 20, one per channel (requires -168 Option)
Printer Port
Type: RS-232C
Connector: Pins (DTE)
Selectable: Baud, parity, data bits, stop bits

Measurement and Output Selection Guide

	Connector	Scanner	Channels	Max Chan/ Chassis
Thermocouple	175	-162[1]	20	100
Direct Voltage	-175 or -176	-162[1]	20	100
Direct Current	-171	-162[1]	20	100
Alternating Voltage	-160	-162[1]	10 ch. V≃ 10 ch. V≃	50 ch. V~ 50 ch. V~
RTD	-177	-163[1]	20	100
RTD	-174	-164[1 2]	20	40
Resistance	-177	-163[1]	20	100
Resistance	-174	-164[1, 2]	20	40
Strain Gage	-174	-164[1, 2]	20	40
Frequency/Event Counting	Included	-167	6	36
Status Input	-179	-168	20	120
Binary Input	-179	-168	1	6
BCD Input	-179	-168	1	6
Status Output	-169	-168	20	120
Analog Output	Included	-170	4	24

[1] A/D Converter (-161) required in each chassis

[2] A dc voltage scanner and companion connector Option (-162 and -176) are also required for each Transducer Excitation Option -164 used for RTDs, Ohms, or Strain measurements

Host Timer
Interval: User defined
Timeout Result: All alarm information sent to printer port

High Performance A/D Converter Option (-161)

One per 2289A and 2281A required for any analog measurement inputs.
Dynamic Range: 100,000 counts
Ranges: ±64 mV, ±512 mV, ±8V, and ±64V dc
Resolution Using DC Scanner Option: 1 µV on 64 mV range, 10 µV on 512 mV range, 100 µV on 8V range, 1 mV on 64V range
Common Mode Noise Rejection: 2170 dB at 50 or 60 Hz ±0.1%; 2160 dB at dc; 100 ohm unbalance
Normal Mode Noise Rejection: 260 dB at 50 or 60 Hz ±0.1%
Operating Temperature: -20°C to 70°C

**Maximum capacity with -201 Option is 1000 channels*

Voltage, Thermocouple Current Inputs

AC Voltage Input Connector Option (-160)

Channels: Ten 2-wire sets of terminals for ac voltage and ten for dc voltage
Voltage Range for AC: 5V rms to 250V rms measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Frequency Range for AC: 45 Hz to 450 Hz
Accuracy for AC: 1% of reading ±0.1V for 90 days. Average-responding conversion; calibrated for rms value of sinewaves
Voltage Range for DC: 64V maximum measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Accuracy for DC: Same as for Option -162 with Option -176
Compatibility: Plugs onto scanner module, Option -162

Thermocouple and DC Scanner Option (-162)

Channels: Twenty per option. One 3-pole dry reed relay for each channel (Hi, Lo, Shield)
Ranges: 64 mV, 512 mV, 8V, and 64V, software-selectable
Input Impedance: ≥200 MΩ on 64 mV and 512 mV ranges, 10 MΩ on 8V, and 64 ranges
Thermal Offset: ≤1 µV each channel
Maximum Input Voltage: 250V dc or rms ac between Hi and Lo terminals
Maximum Common Mode Voltage: 250V dc or rms ac between Hi or Lo and ground or between two adjacent channels

RTDs, Ohms, & Strain Excitation Option (-164)

Five constant current sources for measuring RTDs and/or resistances and a constant voltage source for measuring strain. Channels are configurable in groups of four for either voltage or current excitation. These current sources are factory configured for 1 mA output and are user-modifiable for other ranges. The voltage supply is switch-selectable for either 2V or 4V and can supply up to 250 mA. A bridge completion network is provided for 1/2- and 1/4-bridge strain gages. Requires Connector Option -174. Option -174 and -164 plug together and occupy one I/O slot in Helios-I or 2281A, usually adjacent to the corresponding Scanner Option -162, which is also required.

RTDs, Ohms, & Strain Connector Option (-174)

Channels: Twenty 5-wire sets of screw terminals for connections to RTDs or strain gages. Terminals also provide access to the bridge completion network of Option -164
Compatibility: Plugs onto excitation module, Option -164

Ohms Mode Specifications (Option -164, -174)

Max Resistance	Accuracy* ±(% of Rdg + mΩ)	Resolution	Excitation Current
64Ω	0.02% + 7	1 mΩ	1 mA
512Ω	0.02% + 30	10 mΩ	1 mA

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

RTD Mode Specifications (Option -164, -174)

RTD channel definitions allow you to tailor the instrument to the known characteristics of your probe with a conformity error less than 0.05°C
Resolution: 0.02°C

Temperature Measurement Accuracy*

RTD Type & Range	Maximum Instrument Error
100Ω Platinum RTDs	
-200°C to +200°C 200°C to 600°C	0.1°C 0.15°C
10Ω Copper RTDs	
-75°C to +150°C	1.0°C

**Total Instrument Accuracy, 13°C to 33°C for 90 days.*

Repeatability: ±0.08°C for Platinum RTDs, ±0.2°C for Copper RTDs
Temperature Coefficient: ±10 ppm/°C

Strain Mode Specifications (Option -164, -174)

Full-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges with 2V supply or ten 120Ω bridges with 4V supply
Resolution: 0.25 microstrain
Total System Accuracy: ±(0.05% of rdg + 2 microstrain)*
Temperature Coefficient: ±10 ppm/°C

1/2-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 13 microstrain)*
Temperature Coefficient: ±15 ppm/°C

1/4-Bridge Strain
Capacity: Twenty bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 25 microstrain)*
Temperature Coefficient: ±20 ppm/°C

**20°C to 30°C for 90 days*

Helios-I (2289A)

Temperature Measurement Accuracy, Thermocouples

Thermocouples		Accuracy [1] [3]		
Type & Range	**Temperature °C**	**90 Days 15°C to 35°C**	**1 Year 15°C to 35°C**	**1 Year [2] -20°C to +70°C**
J -200 to 760°C	-100 to -25 -25 to 760	0.45 0.35	0.5 0.4	0.8 0.7
K -275 to 1350°C	0 to 900 900 to 1350	0.4 0.52	0.45 0.65	0.7 1.3
T -230 to 400°C	-100 to 75 75 to 150 150 to 400	0.58 0.35 0.3	0.65 0.39 0.34	1.1 0.7 0.6
E -250 to 838°C	-100 to -25 -25 to 750 750 to 900	0.47 0.3 0.33	0.54 0.33 0.4	0.9 0.6 0.8
R 0 to 1767°C	250 to 450 450 to 1767	0.9 0.8	1.0 0.9	1.3 1.4
S 0 to 1767°C	200 to 1767	0.97	1.1	1.6
B 200 to 1820°C	600 to 800 800 to 1820	1.4 0.96	1.6 1.1	1.9 1.3
N [4] -200 to 400°C	-100 to 150 150 to 400	0.6 0.4	0.7 0.44	1.1 0.7
C 0 to 2315°C	200 to 1000 1000 to 2000 2000 to 2315	0.57 0.90 1.3	0.66 1.2 1.7	0.94 2.1 2.9
JDIN -200 to 900°C	-100 to -25 -25 to 900	0.5 0.4	0.56 0.45	0.9 0.7
TDIN -200 to 600°C	0 to 200 200 to 600	0.48 0.37	0.53 0.41	0.8 0.7

[1] *Total instrument accuracy. Includes all instrument errors such as A/D errors, scanner errors, power supply warm-up, reference junction errors, conformity errors, etc.*

[2] *Total instrument accuracy using Option -162 and -175 in 2281A chassis.*

[3] *A/D Converter must be in 2281A for operation to -20°C or 70°C.*

[4] *For AWG 28 wire.*

Current Input Connector Option (-171)

Channels: Twenty 2-wire pairs of screw terminals for current inputs. Typically for 4 to 20 mA or 10 to 50 mA inputs

Maximum Measurable Current: 64 mA per channel

Current-Sense Resistors: 8Ω ±0.02Ω

DC Current Accuracy: ±(0.25% of reading + 4 counts) for 90 days

Compatibility: Plugs onto scanner module, Option -162

Isothermal Input Connector Option (-175)

Channels: Twenty 3-wire sets of screw terminals for thermocouple or voltage input wires. Large, insulated aluminum block serves as reference junction

Maximum Measurable Voltage: 64V dc

Compatibility: Plugs onto scanner module, Option -162

RTDs & Ohms Connector Option (-177)

Plugs onto the Option -163 circuit card module. Contains five terminals per channel for 20 channels of RTD and resistance input wires. RTD Specifications, Six Classes

- **A** - User-defined high resolution Platinum RTDs
- **B** - High resolution Platinum 385 DIN RTDs
- **C** - User-defined high temperature Platinum RTDs
- **D** - High temperature Platinum 385 DIN RTDs
- **E** - Ten Ohm Copper RTDs, not grounded, electrically insulated
- **F** - Ten Ohm Copper RTDs, grounded (special, consult factory)

RTDs & Ohms Scanner Option (-163)

A 20-channel scanner module for prevision measurements of RTDs and/or resistances.

Measurement Modes: 4-wire or one of two 3-wire modes (both with lead-wire resistance compensation). One 3-wire mode eliminates reed resistance errors

Ranges: Three; 256Ω, 2048Ω and 64 kΩ (or user selectable), software programmed

Current Sources: Two; 1 mA and 32 μA (or user selectable)

Input Isolation: 250V dc or ac rms between separate scanner modules. 250V dc or ac rms between the two decades of channels within a scanner module. 250V dc or ac rms between all channels in two of the three measurement modes. 30V dc or 24V ac rms between terminals of a channel

Ohms Specifications Option (-163, -177)

Range	Resolution @ 60 Hz	±(% of Rdg + Ω)*	
		Accuracy	Repeatability
256Ω	2.4 mΩ	0.017% + 5.7 mΩ	0.0065% + 5.7 mΩ
2048Ω	19 mΩ	0.017% ±38 mΩ	0.0060% ±38 mΩ
64 kΩ	0.6 Ω	0.06% ±1.228	0.0075% ±1.228

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

Voltage Input Connector Option (-176)

Channels: Twenty 3-wire sets of screw terminals for dc voltage input wires

Maximum Measureable Voltage: 64V dc

Compatibility: Plugs onto scanner module, Option -162

DC Voltage Accuracy: ±(% of Rdg + Volts)*

Range	90 Days	1 Year	1 Year**
	15°C to 35°C		-20°C to +70°C
64mV	0.005%+7μV	0.01%+8μV	0.03%+9μV
512mV	0.005%+30	0.01%+40	0.03%+50
8mV	0.005%+700	0.01%+800	0.03%+900
64V	0.009%+3mV	0.02%+4mV	0.05%+5mV

** Total instrument accuracy using Option -162 and -176*

***A/D Converter must be in 2281A for operation to -20°C to 70°C*

RTD Class	Temperature	System		
		Resolution	**Accuracy***	**Repeatability***
A, B	-200 to +150°C +150 to +420°C	0.006°C 0.006°C	0.1°C** 0.15°C**	0.04°C** 0.04°C**
C	-200 to +600°C	0.05°C	0.27°C***	0.16°C***
D	-200 to +600°C	0.05°C	0.28°C***	0.16°C***
E	- 75 to +150°C	0.06°C	0.3°C**	0.17°C**
F	- 75 to +150°C	0.06°C	1.25°C**	0.3°C**

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

***RTD Temperature≤150°C*

****RTD Temperature ≤600°C*

Note: Classes A and C allow the user to perform an ice point initialization and improve total system accuracy to be the sum of repeatability plus 0.03°C for 390 and 392 RTDs. The same procedure for a 385 DIN RTD yields total system accuracy to be the sum of repeatability plus 0.03°C plus the RTD probe conformity error.

Frequency Measurement and Event Totalization Option (-167)

Channels: Six
Functions: Event counting and frequency measurement, selectable per channel pair
Inputs
Signal Types: TTL, CMOS, contacts, analog waveforms
Adjustments: Threshold, deadband, and debouncing
Isolation: Each group of six channels isolated from ground
Frequency Measurement: 400 kHz maximum frequency, 0.001% resolution
Event Counting
Maximum Counts: 8,388,607
Counting Rate: DC to 400 kHz
Operation: Count is reset after each scan
Connector: Screw terminal connector supplied

Digital & Status Inputs & Outputs

Digital Input/Output Module Option (-168)

For controlling up to 20 input or output lines. Handles either 20 status inputs, (one 5-digit BCD input) or one 17-bit binary input, or handles 20 status outputs.
Inputs: Zero volts or contact closures for low, +6 volts maximum for high
Common Mode Voltage: 30V rms ac or dc, maximum
Outputs: Open collector NPN transistors, diode clamped, 28V maximum, 100 mA at 1V
Compatibility: Requires connector Option -179 for inputs or connector Option -169 for outputs

Digital/Status Input Connector Option (-179)

Channels: Twenty 2-wire pairs of terminals for Option -168 plus terminals to select BCD and binary clocking format

Status Output Connector Option (-169)

Channels: Twenty 2-wire pairs of terminals for Option -168. Also terminal provided for clamping diodes when used to drive relays

Analog Output Option (-170)

Outputs: Four per module. Each output has a selectable choice of mode: 0V to 10V, 4 to 20 mA, or 0 to 20 mA
Resolution: 2.44 mV in voltage range, 3.9 μA in 4 to 20 mA range, 4.8 μA in 0 to 20 mA range
Accuracy: ±0.1% of range for 90 days, 15°C to 35°C (calibrated on 0 to 10V range)*
Isolation: Each group of four channels isolated from ground and other channels up to 45V
Compliance Current in Voltage Mode: 5 mA sinking, 20 mA sourcing
Compliance Voltage in Current Mode: 10V
Temperature Range: -20°C to +70°C, operating in 2281A
Connector: Included with option

* *0.1% accuracy also obtainable on current ranges with recalibration. Current ranges have accuracy of ±0.25% when shipped from the factory*

2281A Power Supply Option (-431)

Although power for a 2281A Extender Chassis is normally supplied by a 2289A mainframe via a 2281A-402 Cable, a built in power supply Option (2281A-431) is available and is required when the distance to a 2281A and/or the current drain of the 2281A is heavy because of the number of options installed. The 2281A-431 power supply will operate on ac power or a 12V or 24V dc supply, either of which will trickle charge a 12V battery for battery backup in the event of a power failure. Ask your Fluke Sales Office or Representative for Configuration Form F605 to determine what options may be in stalled in a 2281A at what distances without Option 2281A-431.
Operating Temperature: -20°C to +70°C

Ordering Information

Models

January 1989 prices

2289A Helios-I Mainframe	$2300
2289A/AA Helios-I (dc powered)	on req
22810A Helios-I (including -161, -162 and -175)	3930
2281A Extender Chassis (1m cable included)	850

Hardware Options (for above Models)

-160 AC Voltage Connector	295
-161 High Peformance A/D Converter	800
-162 Thermocouple/DC Voltage Scanner	650
-163 RTD/Resistance Scanner	995
-164 Transducer Excitation Assembly	690
-167 Counter/Totalizer, w/connector	950
-168 Digital I/O Assembly	720
-169 Status Output Assembly w/connector	120
-170 Analog Output Assembly w/connector	995
-171 Current Input Assembly	$200
-174 Transducer Excitation Assembly	395
-175 Thermocouple Input Connector	180
-176 DC Voltage Connector	100
-177 RTD/Resistance Connector	210
-179 Digital/Status Connector	100
-201 Scan/Alarm Option	990
-402 Extender Chassis Cable	5/m
-403 Connector Pair for -402 Cable	95
-431 Extender Chassis Power Supply	530

Software Options

2289A-901 Helios Toolbox for BASIC Programmers	350
2289A-902 CIMPAC Application Software Package	3695
S2289 ProLogger_HCL Application Software	295
S2290 LABTECH Notebook Application Software	995

Accessories (Also see page 485)

Y1702 RS-232C Null Modem Cable, 2m	125
Y1703 RS-232C Null Modem Cable, 4m	150
Y1705 RS-232C Null Modem Cable, 30cm	75
Y1707 RS-232C Standard Cable, 2m	125
Y1708 RS-232C Standard Cable, 10m	150
Y2044 24" Rack Slide and 8" Rack Mount Kit	195
Y2045 8" Rack Mount Kit	150
Y2047 Extender Chassis 3-Way Connector	75

Sales & Support

Warranty

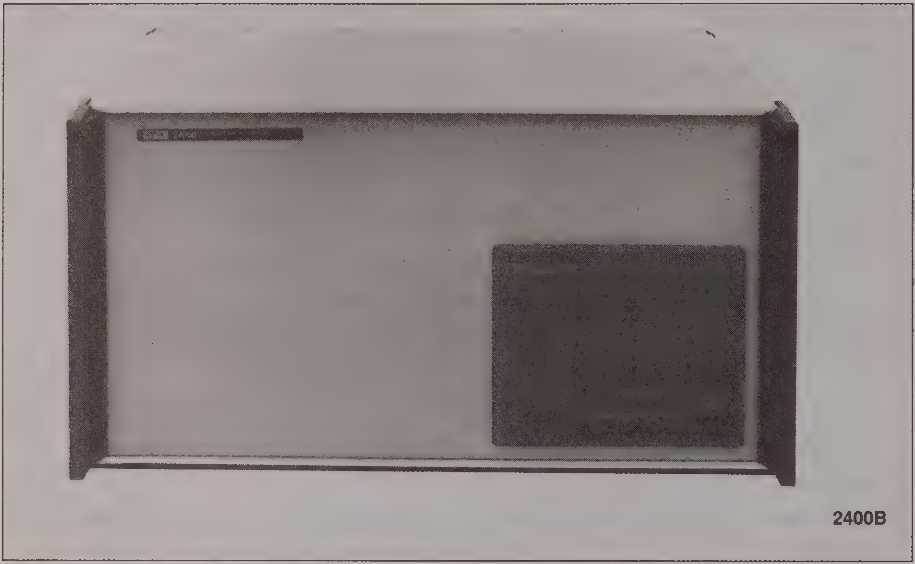
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

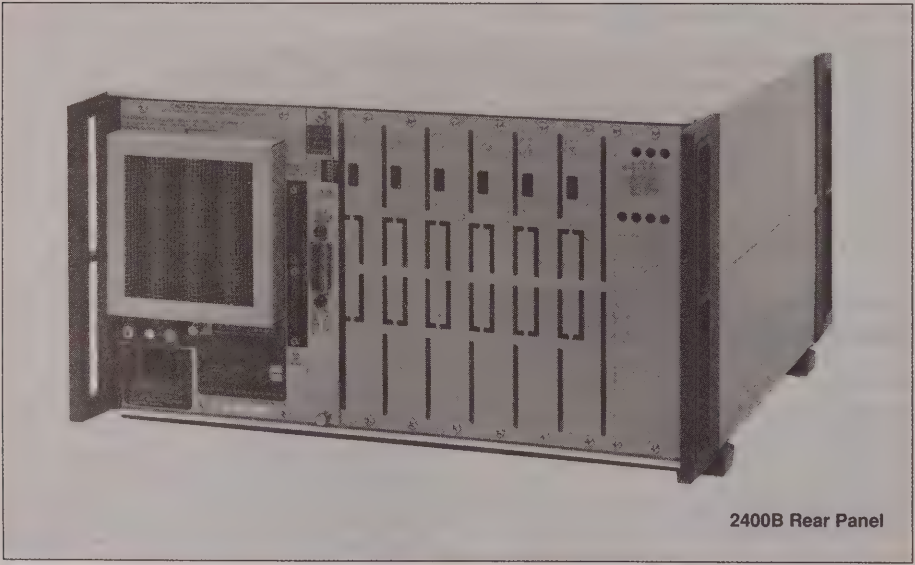
SC1-2289A Repair (w/calibration)	392
SC1-2289A Repair (cal w/in or out data)	427
SC1-2289A Repair (cal w/in and out data)	462
SC2-2289A Cal (1 per yr recommended)	94
SC2-2289A Cal (1 per yr w/ in or out data)	129
SC2-2289A Cal (1 per yr w/in & out data)	164
SC1-22810A Repair (w/calibration)	392
SC1-22810A Repair (cal w/in or out data)	427
SC1-22810A Repair (cal w/in and out data)	462
SC2-22810A Cal (1 per yr recommended)	94
SC2-22810A Cal (1 per yr w/in or out data)	129
SC2-22810A Cal (1 per yr w/in & out data)	164
SC1-2281A Repair (w/calibration)	226
SC1-2281A Repair (cal w/in or out data)	261
SC1-2281A Repair (cal w/in and out data)	296
SC2-2281A Cal (1 per yr recommended)	94
SC2-2281A Cal (1 per yr w/in or out data)	129
SC2-2281A Cal (1 per yr w/in & out data)	164

2400B

GPIB IEEE-488



2400B



2400B Rear Panel

2400B Intelligent Computer Front End

- A data acquisition "computer" in itself — measures, alarms, and controls independent of host
- Handles nearly any I/O requirement with an extensive selection of options
- High accuracy analog measurements — even in electrically noisy environments
- Modularly expandable (over 3000 total channels) to meet future application demands
- Interface to nearly any computer via RS-232, RS-422, GPIB/IEEE-488, or current loop
- Self documenting, structured program language — optimized for measurement and control
- EPROM program storage available for stand-alone dedicated applications

The 2400B Intelligent Computer Front End is a very accurate microprocessor-based analog and digital data acquisition system. The system serves as an interface between a computer and both the measurement and control of a physical process.

The 2400B can receive a measurement and control program from the host computer and, upon command, execute it without further interaction with the computer. The 2400B relieves the host of routine, time consuming tasks and greatly simplifies the programmer's task of developing system software. Cost savings is the result, and greater throughput is possible because the computer can perform other tasks at "computer speed" without waiting for physical events.

The 2400B works well in applications requiring a distributed data acquisition and control system. With a Serial Interface Option (-001) 2400Bs may be located over 1220 meters (4000 feet) from the host computer in a star or daisy chain configuration.

Computers with which the 2400B will inter face are those with either RS-232-C, RS-422, GPIB/IEEE-488*, or 20 mA current loop compatibility. The Fluke 1752A Instrument Controller interfaces well with the 2400B and the combination (called a 2452MCS) is described in following pages.

Hardware costs are reduced by having a wide range of user-configurable, input and output plug-in circuit cards plus different types of extender chassis and interface options to perform the necessary measurement and control functions of your application. The 2400B has a maximum system capacity of over 1000 analog inputs, 1000 digital inputs, 128 analog outputs, and 1000 digital outputs.

Inputs

The 2400B accepts inputs from a wide variety of sources and transducers. For analog inputs, the 2400B uses its 17-bit analog-to-digital converter to perform accurate measurements of ac or dc voltage, current, or temperature using thermocouples. Integral signal conditioners are used in conjunction with the A-to-D converter to perform measurements of resistance, temperature (RTDs), strain, and certain other transducers.

Built-in linearizations are available for a wide variety of thermocouples. RTD linearizations are software-selectable by individually select ing parameters for different probes, assuring high accuracy.

Totalizing, as well as frequency, period, and rotation speed measurements, are performed with one of the Counter/Totalizer Options. To sense switch closures or logic levels, you may use the Status Input Option. Or, for faster response, use the Interrupt Input Option or the Sequence of Events Recorder Option. The Interrupt Option causes the 2400B to respond to external events immediately while the Sequence of Events Option records events with up to 0.1

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

millisecond resolution. The Digital Input Option is used to read either 7-digit BCD or 24-bit binary words from devices with that output capability.

Outputs

The 2400B makes use of five different control output options. To light annunciators, or per form on-off control, use the Status Output Option or the Relay Output Option. Use the 2400B's other output cards for more complex process control. A Resistance Output Option may be programmed to supply resistances from 0 to 100,000 ohms. For -10V to +10V dc or 4 to 20 mA control loops, or driving analog recorders, use the Analog Output Option. To control stepper motors, use the Stepper Motor Output Option. Frequency and acceleration rates may be selected through the 2400B's software for stepper motor control.

Expandability

A 2400B system may be large or small, depending upon the application. The 2400B main frame has six slots for any combination of input, output, or interface plug-in modules. To expand the system, just add extender chassis. However, only one A-to-D converter is needed for a 2400B system to measure analog signals, even if the maximum number of channels is installed.

Several 2400Bs may be interfaced to a single computer. When equipped with either the RS-422, or 20 mA current loop interface, 2400Bs may be arranged in a multi-drop configuration at distances up to 1220 meters (4000 feet) from the host computer. Greater distances are possible utilizing the 2400B's RS-232-C interface and modems, over existing telephone lines.

Flexible Software

The 2400B can be utilized with two "levels" of software. The first level is for immediate-mode commands, those which cause an immediate response from the 2400B. The second level is the program stored in the 2400B, allowing the 2400B to monitor and measure inputs, perform calculations, make decisions, and set control outputs, all independent of the host computer.

Stand-Alone Capability

By loading the 2400B's stored program into EPROMs in the mainframe, the 2400B can be used to monitor inputs, perform calculations, and update control outputs, without being connected to a host computer. Using one or both of the 2400B's RS-232 ports in conjunction with the Fluke Touch Control Screen Series allows stored program data to be presented and modified by an operator, all under the program's control. Approximately 400 lines of 2400B program may be stored in EPROM.

Worldwide Support

Service centers for Fluke products are located in more than forty countries around the world. Many offer full service contracts for maintenance and repair at your site. Or training for your personnel can be arranged. We know how important it is to be assured of expert maintenance for systems you depend on, even though they may be among the most troublefree available — like those from Fluke.

Specifications

2400B System

Analog Inputs: ≤1000 isolated, 3-, 4-, or 6-wire channels
Digital Inputs: ≤1024 non-isolated lines, configurable for either (1) 7 BCD digits plus 1 sign bit plus 3 bits for decimal point location or (2) 24-bit binary plus 1 sign bit
Status Inputs: ≤1024 electrically isolated wirepairs
Interrupt Inputs: 132 electrically isolated wirepairs
Counter-Totalizer Inputs: 132 isolated analog and 132 non-isolated TTL inputs
Status Outputs: ≤1024 electrically isolated wirepairs
Analog Outputs: ≤128 voltage and/or current sources in range of -10V to +10V or 0 to 20 mA
Resistance Outputs: 164 resistance sources with 1Ω increments to 4095Ω and/or 25Ω increments to 102,375Ω
Stepper Motor Outputs: ≤32 direct or logic level outputs

2400B Mainframe

The 2400B must have either option -001 or Option -002 installed to be operational.
Capacity: Six slots for any combination of input, output, or extender chassis interface plug-in modules. A-to-D converter module (Option -109) installed in a dedicated additional slot
Serial Outputs: EIA Standard RS-232-C, two ports, output only

Options

Serial Interface Option (-001)

Bi-directional serial interface to compatible host computer. This option is configurable as either an RS-232-C, RS-422, or 20 mA current loop via a changeable jumper. As an RS-232-C interface, Option -001 supports five protocols.

IEEE-488 Interface Option (-002)

Bi-directional IEEE-488 interface to compatible host computer or instrument controller such as Fluke 1722A.

2401A Scanner Extender Chassis

Capacity: Ten scanner modules (Option -101, -115, or -117) 100 analog input channels
System Size: Ten maximum
Maximum Distance: 15 meters (50 feet) from 2400B or 2403A. A 2-meter cable included

2402A I/O Extender Chassis

Capacity: 12 input and/or output plug-in modules. Option 2402A-501 required. Installed in 2400B
System Size: 16 maximum
Maximum Distance: 15 meters (50 feet) from 2400B. A 2-meter cable included

2403A Remote A/D Extender Chassis

Capacity: Eight slots for signal conditioners, scanner modules (Option -101, -115 or -117) plus two slots for Interface Options (-401) for up to ten 2401s. One A/D module required (Option -109). Option 2403A-601 also required
Maximum Distance: 1220 meters (4000 feet) from 2400B. Order cable by length (Opt -602) plus installed connectors (Opt -603)

High Performance A/D Converter Option (-109)

Required for all analog measurement inputs. Only one allowed for each 2400B System.
Input Resistance: <200 MΩ in 0.1V, 0.8V, and 6.4V range; 10 MΩ in 100V range
Input Capacitance: 0.005 μF at 25 readings per second; 0.5 μF at 3 readings per second
Zero Stability: Automatically zeroed before each measurement

Voltage, Current, Thermocouple Inputs

High Performance Scanner Option (-101)

Ten 3-wire dry reed relays (Hi, Lo, shield).
Thermal Offset: <1 μV per channel
Maximum Voltage: 350V dc or peak ac between any input terminal and system ground or other terminal
Temperature Resolution: 0.1 degree (one count)

Thermocouple and DC Voltage Input Connector Option (-102)

Ten 3-wire sets of screw terminals on isothermal block enclosed in a safety housing. Integral reference junction correction for 0°C. Plugs into Scanner Module (Option -101).

DC Voltage Input Connector Option (-108)

Ten 3-wire sets of screw terminals for input wires enclosed in safety housing. Plugs into scanner module (Option -101)
Range: -100V to +100V
Maximum Voltage: 350V dc or peak ac. See Option -101

2400B

Temperature Measurement Accuracy

Measurement may be performed in Celsius, Fahrenheit, Kelvin, or Rankine (w/option -101, -102)

Thermocouple Type	Range °C	24 hours 21°C to 25C°		90 Days 18°C to28°C		1 Year 13°C to 33°C	
		Low Reading Rate	High Reading Rate	Low Reading Rate	High Reading Rate	Low Reading Rate	High Reading Rate
JNBS	-200 to -160	0.40	0.55	0.50	0.60	0.70	0.75
	-160 to 0	0.30	0.40	0.35	0.45	0.50	0.55
	0 to 760	0.20	0.25	0.25	0.30	0.35	0.35
KNBS	-225 to -210	0.70	1.00	0.85	1.10	1.30	1.40
	-210 to -160	0.55	0.80	0.65	0.90	1.00	1.10
	-160 to -80	0.35	0.50	0.40	0.55	0.60	0.70
	-80 to +1350	0.25	0.35	0.30	0.40	0.45	0.50
TNBS	-230 to -210	0.70	0.95	0.80	1.05	1.20	1.35
	-210 to -150	0.50	0.75	0.60	0.80	0.95	1.05
	-150 to -50	0.35	0.50	0.40	0.55	0.60	0.70
	-50 to +400	0.25	0.35	0.30	0.40	0.45	0.50
ENBS	-250 to -230	1.00	1.25	1.15	1.40	1.65	1.80
	-230 to -180	0.60	0.75	0.70	0.85	0.95	1.05
	-180 to 0	0.35	0.45	0.40	0.50	0.55	0.60
	0 to +1000	0.20	0.25	0.25	0.30	0.30	0.35
RNBS	0 to 60	0.80	1.55	1.00	1.75	1.95	2.35
	60 to 200	0.65	1.25	0.80	1.40	1.55	1.85
	200 to 600	0.50	0.95	0.65	1.10	1.20	1.40
	600 to 1767	0.40	0.75	0.50	0.85	0.95	1.10
SNBS	0 to 60	0.80	1.55	1.00	1.75	1.90	2.30
	60 to 200	0.65	1.25	0.80	1.40	1.55	1.85
	200 to 600	0.55	1.00	0.65	1.10	1.25	1.50
	600 to 1767	0.45	0.85	0.55	0.95	1.05	1.25
BNBS	200 to 420	2.00	4.05	2.55	4.60	5.10	6.10
	420 to 750	1.00	1.95	1.25	2.15	2.40	2.85
	750 to 1150	0.60	1.15	0.75	1.30	1.45	1.70
	1150 to 1850	0.45	0.85	0.55	0.95	1.05	1.25
NNBS**	-200 to -170	0.60	0.95	0.70	1.05	1.20	1.35
	-170 to 0	0.45	0.70	0.55	0.80	0.85	1.00
	0 to 1300	0.25	0.40	0.30	0.45	0.50	0.55
CHOS***	0 to 1200	0.40	0.65	0.45	0.75	0.80	0.95
	1200 to 2315	0.55	0.95	0.70	1.10	1.25	1.45
JDIN	-200 to -100	0.35	0.40	0.40	0.45	0.50	0.55
	-100 to 200	0.25	0.30	0.30	0.35	0.40	0.45
	200 to 900	0.20	0.25	0.20	0.25	0.30	0.30

Includes all but sensor error: connector gradient, reference junction, linearization conformity, A-to-D conversion, temperature coefficient, time drift, scanner offset.

** *Nicrosil/Nisil*

*** *Hoskins Mfg. Co. Tungsten - 5% Rhenium vs Tungsten - 26% Rhenium*

DC Voltage Measurement Accuracy:

±(% Rdg + Counts + µV)*

Scan Rate	24 Hours 21°C to 25°C	90 Days 18°C to 28°C	1 Year 13°C to 33°C
0.1V, 0.8V, 6.4V Ranges			
3CH/S	±(0.002%+2+2)	±(0.005%+3+2)	±(0.015%+4+6)
25CH/S	±(0.002%+4+4)	±(0.005%+5+4)	±(0.015%+6+6)
100V Range			
3CH/S	±(0.008%+2+0)	±(0.01%+3+0)	±(0.02%+4+0)
25 CH/S	±(0.008%+4+0)	±(0.01%+5+0)	±(0.02%+6+0)

* *After 45 minute warm-up. With Option -109, -101, and -108 (or -102)*

AC Voltage Input Connector Option (-119)

Ten sets of 2-wire screw terminals for input wires enclosed in a safety housing. Plugs into scanner module (Option -101).

Voltage Range: 5V rms to 250V rms

Frequency Range: 45 Hz to 450 Hz

Conversion Method: 1/2-wave, average-responding, calibrated to indicate rms value of sinewave

Maximum Voltage: 250V rms or 250V dc

Accuracy: ±(1.0% of input +0.1V)

Current Input Connector Option (-106)

Specifications are the same as for Option -101 but with a precision 15Ω, 0.25 watt resistor in each channel to convert current to voltage. For 4 to 20 mA sources; 129 mA maximum. Plugs into Scanner Module (Option -101). Some other current values available on request.

RTDs, Ohms, 1/4-Bridge Strain Inputs Signal Conditioner Option (-701)

For Ohms, RTD, 1/4-bridge strain measurements.

Configuration: 3- or 4-wire, switch-selectable

Excitation Currents: 100 µA, 1 mA, 10 mA, switch-selectable

Accuracy: ±0.005% at calibration, 21°C to 25°C

Four-Wire Scanner Option (-115)

Capacity: Ten 4-wire channels (reed relays)

Noise Rejection: Same as Option -109 except common mode rejection is 120 dB and normal mode rejection is 60 dB

Maximum Voltage: 170V dc or peak ac between any channel and any other channel and/or ground. 30V dc or rms ac between any two lines on the same channel

Connector Option: Use 2400A-116

Note: This scanner may not be used for voltage measurements.

Four-Wire Input Connector Option (-116)

Ten 4-wire sets of screw terminals for input wires enclosed in safety housing. Plugs into Scanner Module Option (-115)

Maximum Voltage: Same as for Option -115.

Ohms Mode Specifications

Max Resistance	Resolution	Excitation Current
64,000Ω	1.0Ω	100 µA
8000Ω	0.1Ω	100 µA
800Ω	0.01Ω	1 mA
100Ω	0.001Ω	1 mA
10Ω	0.0001Ω	10 mA

Total System Accuracy: For 90 days, 18°C to 28°C, at 25 readings per second

Four-Wire: ±(0.021% of reading + 0.01% range)

Three-Wire: ±(0.021% of reading + 0.02% range + 0.21Ω)

RTD Mode Specifications

Resolution: 0.03°C

Total System Accuracy: For 90 days, 18°C to 28°C, at 25 readings per second, 4-wire:

100Ω Pt RTD with alpha = 0.00385: ±0.2°C at 0°C, ±0.3°C at 600°C

1/4-Bridge Strain Mode Specifications

Total System Accuracy*
350Ω Gage: ±(0.042% of reading + 14 microstrain)
Resolution: 0.2 microstrain
120Ω Gage: ±(0.042% of reading + 16 microstrain)
Resolution: 0.5 microstrain

1/2- and Full-Bridge Strain Measurements

Signal Conditioner Option (-702)

For 1/2- and full-bridge strain measurements
Excitation Voltage: 4,5,8,10,12,15, or 20V dc, software-selectable

Six-Wire Scanner Option (-117)

Capacity: Five 6-wire channels (reed relays)
Conductors: Excitation source (2); remote sense (2); analog input (2)
Noise Rejection: Same as Option -109 except common mode rejection is 120 dB and normal mode rejection is 60 dB
Maximum Voltage: 170V dc or peak ac between any channel and any other channel and/or ground. 30V dc or rms ac between any two lines on the same channel.
Connector Option: Use 2400A-118

Six-Wire Input Connector Option (-118)

Five 6-wire sets of screw terminals for input wires enclosed in safety housing. Plugs into six-wire scanner module Option -117

Total System Accuracy*

1/2-Bridge Mode: ±(0.015% of rdg + 4.5 microstrain) with both gages principally active
Full-Bridge Mode: ±(0.015% of rdg + 4.5 microstrain) with two gages principally active
Resolution: 0.5 microstrain

** For 90 days, 18°C to 28°C, 25 readings per second, 350Ω gage, 4V excitation*

Other Input Specifications

Counter/Totalizer Signal Input Option (-113)

May be used to perform the following measurements: Frequency, period, totalize, tachometer, "A" gated by "B", and time interval.
Inputs: TTL, Gate 1, Gate 2, Trigger, Count Up, Count Down, Up/Down, Count, Non-Isolated Common, Isolated Common, Isolated Analog Input
Analog Input Voltage Range: 50 mV to 30V rms
Frequency Range: 0 to 900 kHz (TTL Input); 10 Hz to 200 kHz (Analog Input)

Period Range
TTL Input: 1.1 µs to 6.7s
Analog Input: 5 µs to 0.1s
Period Resolution: 400 ns

Time Interval Range
TTL Input: 1 µs to 3.82 hr
Analog Input: 2 µs to 50 ms
Time Interval Resolution: 819 µs (≤3.82 hours); 400 ns (≤6.7 seconds)
Totalizer Input Range: Dc to 900 kHz
Minimum Pulse Width: 400 ns
Totalizer Capacity: -8,388,608 to +8,388,607
Connector: 12 screw terminals supplied with option

4 Channel Counter/Totalizer Option (-113/AA)

Measures period, frequency, time interval, and totalizes
Inputs: Four channels, non-isolated
Frequency Range: 0-500 kHz
Period Range: 10 µs to 50,000s
Totalizer Capacity: 4,999,999
Input Voltage Range: 175 mV to 70V rms
Connector: 12 screw terminals supplied with option

Digital Input Module Option (-103)

BCD Mode: 7 BCD digits +1 sign +3 decimal position bits
Binary Mode: 24 bits +1 sign bit
Logic Level: TTL, 0 to +0.75V low, +2.5 to +8V high
Rate: ≤250 words per second
Connector Options: Use 2400A-110 or -111

Status Input Module Option (-104)

Bits Per Module: 32, isolatable from system ground or other modules by up to 30V dc or peak ac
Format: Individually readable
Input: Contact closures or TTL level
Connector Option: Use 2400A-110 or -111

Sequence of Events Recorder Option (-104/AA)

Number of Inputs: 32 channels
Channels Per System: 1024 max
Resolution: 0.1 ms to 100 ms, selectable
Connector Option: Use 2400A-110 or -111

Interrupt Signal Input Option (-114)

Number of Inputs: 16
Input Logic: Contact closures or TTL level, switch-selectable
Connector Option: Use 2400A-110 or -111

Screw Terminal Connector Option (-110)

Terminals: 50, for wire sizes up to #14 AWG

Solder Pin Cable Connector Option (-111)

Terminals: 50, for wire sizes up to #22 AWG

Control Output Specifications

Analog Control Output Option (-302)

Outputs: Isolated. Four per module. Voltage (-10V to +10V) or current (0 to 20 mA), individually selectable
Isolation: ≤30V dc or peak ac, channel to channel
90-Day Accuracy: ±20 mV in voltage mode and ±20 µA in current mode for ambient temperature of 18°C to 28°C
Connector Option: Use 2400A-110 or -111

Status Output Control Option (-301)

Outputs: 32, open collector, diode clamped.
Isolation: ≤30V dc or peak ac, channel to channel or channel to ground
Connector Option: Use 2400A-110 or -111

Relay Output Card Option (-301/AA)

Number of Contacts: 16
Contact Rating: 250V ac at 3A with non-inductive load and 28V dc at 3A
Contact Arrangement: Form "C" (N.O. or N.C.)
Connector: Terminals supplied with option

Resistance Output Control Option (-305)

Outputs: Two
Isolation: 130V dc or peak ac channel to channel or channel to ground
Values: 0 to 4095Ω in 1Ωincrements
Connector: Four screw terminals supplied with option

Resistance Output Control Option (-306)

Outputs: Two
Isolation: ≤30V dc or peak ac, channel to channel or channel to ground
Values: 0 to 102,375Ω in 25Ω increments
Connector: Four screw terminals supplied with option

Stepper Motor Control Output Option (-307)

Number of Outputs: One, non-isolated
Input Signals: External Enable, Closed-Loop Feedback
Direct Output Signals: Four-Phase Unipolar Drive, Flyback Protected
Logic Output Signals: CW/CCW direction and Step Clock, or CW and CCW Clock Outputs; Busy/Done
Acceleration and Deceleration Rates: 114 Hz/ second to 97656 Hz/second. Software-selectable
Connector: 12 screw terminals, supplied with option

Note: Option -307 may be configured as a frequency source. Ask about Option -307/ABK

General Specifications

Shock and Vibration: Meets MIL-T-28800, Class 3 requirements

Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating

Relative Humidity: ≤80% to 40°C and ≤70% to 50°C, operating, non-condensing

Power: 90 to 132V ac or 180 to 264V ac, switch-selectable, 50 or 60 Hz ±2 Hz, 130 watts maximum

Size: 22 cm H x 43 cm W x 38 cm D (8.66 in x 16.9 in x 14.96 in) for 2400B, 2401A, 2402A, and 2403A. Fit standard 19-inch rack

Weight*

2400B: 11.4 kg (25 lb)
2401A: 6.4 kg (14 lb)
2402A: 11 kg (24 lb)
2403A: 8.2 kg (18 lb)

**Approximate, fully loaded*

Included: Manual Set, Getting Started Guide and power cord

Ordering Information

Models

January 1989 prices

2400B* Intelligent Computer Front End	$4900
2401A Scanner Extender Chassis	1500
2402A I/O Extender Chassis	2400
2403A Remote A/D Extender	1850

**Option -001 or -002 is required*

Options (for above models)

-001 Serial Interface	840
-002 IEEE-488 Interface	840
-101 High Performance Scanner	500
-102 Thermocouple Input Connector	200
-103 Digital Signal Input	475
-104 Status Signal Input	$570
-104/AA Sequence of Events Recorder	on req.
-106 Current Input Connector	240
-108 DC Voltage Input Connector	150
-109 High Performance A/D Converter**	1285
-110 Screw Terminal I/O Connector	150
-111 Solder Pin I/O Connector	50
-113 Counter/Totalizer Signal Input	675
-113/AA 4 Channel Counter/Totalizer	on req.
-114 Interrupt-Signal Input	590
-115 Four-Wire Scanner	520
-116 Four-Wire Input Connector	150
-117 Six-Wire Scanner	575
-118 Six-Wire Input Connector	150
-119 AC Voltage Input Connector	230
-301 Status Output	550
-301/AA Relay Output	on req.
-302 Current/Voltage Analog Output	995
-305 Resistance Output (1Ω-4 kΩ)	710
-306 Resistance Output (25Ω-100 kΩ)	710
-307 Stepper Motor Control Output	750
-401 Scanner Extender Interface	170
-402 Extender Cable (custom length)	25/m
-403 Connectors for 2401A-402 Cable	220
-501 I/O Extender Interface	340
-502 I/O Cable (with connectors, 9m)	315
-601 Remote A/D Extender Interface	290
-602 A/D Extender Cable (custom length)	5/m
-603 Connectors for 2403A-602 Cable	75
-701 Signal Conditioner for Ohms, RTD's 1/4- & 1/2-Bridge Strain Measurements	575
-702 Signal Conditioner for 1/2- and Full-Bridge Strain Measurements	685

***Required for analog measurements*

Accessories (Also see page 485)

Y1707 2m Cable for RS-232-C	$125
Y1705 RS-232-C Null Modem Cable	75
Y8022 IEEE-488 Shielded Interface Cable, 2m	145
Y2053 Rack Adapter w/24" slides	195
Y2054 19" Rack Adapter w/o slides	150
Y2055 RS-422 Multi-connector	95

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2400B Repair (w/ calibration)	689
SC1-2400B Repair (cal w/in or out data)	724
SC1-2400B Repair (cal w/in and out data)	759
SC2-2400B Cal (1 per yr recommended)	126
SC2-2400B Cal (1 per yr w/in or out data)	161
SC2-2400B Cal (1 per yr w/in & out data)	196
SC1-2401A Repair (w/ calibration)	204
SC1-2401A Repair (cal w/in or out data)	239
SC1-2401A Repair (cal w/in and out data)	274
SC2-2401A Cal (1 per yr recommended)	94
SC2-2401A Cal (1 per yr w/in or out data)	129
SC2-2401A Cal (1 per yr w/in & out data)	164
SC1-2402A Repair (w/ calibration)	230
SC1-2402A Repair (cal w/in or out data)	265
SC1-2402A Repair (cal w/in and out data)	300
SC2-2402A Cal (1 per yr recommended)	94
SC2-2402A Cal (1 per yr w/in or out data)	129
SC2-2402A Cal (1 per yr w/in & out data)	164
SC1-2403A Repair (w/ calibration)	287
SC1-2403A Repair (cal w/in or out data)	322
SC1-2403A Repair (cal w/in and out data)	357
SC2-2403A Cal (1 per yr recommended)	94
SC2-2403A Cal (1 per yr w/in or out data)	129
SC2-2403A Cal (1 per yr w/in & out data)	164

1752A

GPIB
IEEE-488

1752A

1752A Data Acquisition System

- Analog measurements to 1,000 per second, accuracy of 0.02%
- Touch Sense Graphics Display
- High performance processor with Macrostore™ floating point processing
- 136K bytes of RAM. Expandable to 3.0M bytes
- 400K-byte floppy disk
- BASIC. Programmable with real-time and measurement and control extensions
- GPIB/IEEE-488, RS-232/422, Current Loop and Parallel Interfaces
- Rack mountable with removable keyboard
- Analog Control Option (voltage or current)
- Status Input/Output Option
- Counter/Totalizer Option
- Signal conditioning for dc/ac volts, thermocouples, RTD, strain

The Fluke 1752A Data Acquisition System is a powerful microcomputer-based system for measurement and control applications. The data acquisition functions are integrated into the same chassis as the computer to minimize desktop or rack space, simplify programming, and increase system performance. The 1752A's BASIC offerings provide a structured programming environment tailored for high speed data acquisition and instrument control. Single-word commands simplify the task of writing programs for both data acquisition and GPIB/IEEE-488* compatible instrument control.

Its touch screen replaces a keyboard or switch panel, allowing the operator to respond to prompts one at a time. System control may then be accomplished by simply touching the screen.

High Performance Microcomputer

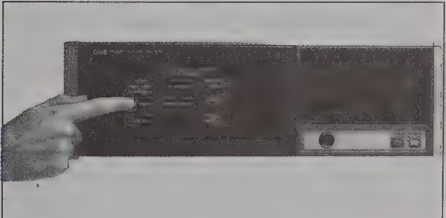
The 1752A is a microcomputer designed for control of automated instrument systems in the laboratory, the plant, or the factory and for information management systems.

The 1752A's high speed 16-bit microprocessor uses a 24 MHz clock to achieve an instruction cycle rate of 6 MHz. High-speed floating point arithmetic processing is implemented through extensions to the microprocessor instruction set. A separate display processor, with high speed vector generator and graphics memory workspace, functions as an independent graphics display terminal for the central processor.

The 1752A is easily configured to automatically start running your application software. On power-up the 1752A loads operating software from its internal floppy disk then executes a command file which instructs it to perform any desired task sequence. Alternatively, the 1752A may be operated as a diskless system when equipped with optional non-volatile RAM. Additionally, since the operating software is soft-loaded, updating is as easy as inserting a new disk and restarting.

RAM memory in the 1752A can be partially allocated as a file-structured electronic disk for high speed task overlays and large fast-access virtual data arrays. Software development tools make the task of writing programs more efficient through such features as wildcard file identification, utility command files, and recall of previously typed commands.

The 1752A includes four slots for additional memory and interface options. The standard 136K RAM memory is internally expandable to over 3 megabytes. The 400K-byte internal floppy disk drive capacity can be expanded through the 1760A or 1761A Disk Drives to 2 megabytes of on-line floppy disk file storage. An external Winchester Disk Drive System brings 20 megabytes of file capacity on-line. Non-volatile RAM options can be installed for rugged, permanent file storage, especially suited for harsh environments. Up to 2.5M bytes of non-volatile memory may be installed.



Touch-Sensitive Display System

Touch-Sensitive Display System

With its touch-sensitive display, the 1752A is particularly well suited for applications where semi-skilled personnel need to operate complex systems performing sophisticated tasks. The friendly graphics display takes the place of the often-intimidating keyboard, yet offers access to the software that keeps your system running. An operator is prompted one step at a time for information or decisions through informational displays, and responds by simply touching the screen. Systems based on this concept are

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The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

easily updated for new tasks: the cost and downtime of installing new switch or key labels is eliminated.

Fluke's experience producing the touch-sensitive display overlay goes back to 1979. It has proven to be a rugged, reliable component.

Characters Plus Graphics

The graphics display capability of the 1752A is independent of its character display, and of the 1752A central processor. With its own display processor, high speed vector generation hardware, and 64K graphics display memory, the 1752A is a sophisticated tool in the hands of the creative system designer. The 64K display workspace is over three times the size of the 640 by 224 pixel display window: 2048 pixels wide by 256 pixels high. You can use it to display data in strip chart form, and move the display across the window by touch commands. You can also use it to prepare up to three independent data screens available for instant display. Once the graphics display is generated, a hard copy of the graphics plane can be printed under program control.

The 1752A character display is an independent function that can overlay graphics data displays for labels, or be used alone for text and for programming. Because the graphics and character displays can be independently enabled, screens can be prepared "off-line" and displayed when ready. Numerous ANSI-compatible character attributes are available to add emphasis to portions of displays. Attributes such as inverse or underline can be pre-defined for display fields, or made a part of characters as they are sent to the screen.

The 1752A includes an industry standard composite video output that will display whatever is on the 1752A screen on a video monitor. This can be useful for training presentations as well as for system requirements that include a remotely mounted display.

Data Acquisition and Control

The 1752A-010 Analog Measurement Processor allows the 1752A to connect to 16 differential or 32 single-ended inputs, and acquire data at up to 1,000 readings per second. Multiple 1752A-010's may be installed to increase system throughput to 4,000 readings per second. (Any single input, however, can be sampled at a maximum rate of 1,000 per second.) Normal mode rejection may be added through either internal line synchronization, or external synchronization, using the Y1752A Line Synchronization Transformer. The Analog Measurement Processor interfaces to the 1752A bus without isolation. Inputs are protected against damage to 50V dc, and fused input resistors decrease the risk of dangerous higher voltages reaching system operators. An external signal conditioning subsystem is available which provides isolation as well as signal conditioning for inputs such as ac voltages, thermocouples, RTDs and strain.

For analog control, use the 1752A-011. This option allows the 1752A to control devices which accept a 0 to 20 mA or a ±10V dc control signal. Each of the four outputs can be individually configured for either current or voltage.

For frequency, time, and totalizing measurements, the 1752A-012 option offers a single input. To sense switch closures or logic levels, as well as perform on-off control, use the 17XXA-002 Parallel Interface. This option offers 32 bits configurable for either input or output. To switch higher levels, an optional digital isolation subsystem is available. To expand your system, use the 1702A Extender Chassis. This increases the number of slots available for measurement and control options by 11. More 1702As may be added for larger systems.

Interfacing

The 1752A includes an IEEE-488 bus interface and an RS-232-C serial data port. The IEEE-488 interface can control up to 14 instruments at transfer rates of up to 30K bytes per second. Powerful IEEE-488 commands are supported as a part of each 1752A programming language. The 1752A can be set up to function as a system controller or as an addressable device in a multiple-controller system. In either configuration, the 1752A can pass control to another controller and take it back when offered. As system controller, the 1752A starts up as controller-in-charge and can use IFC (Interface Clear) to reset all bus devices.

Three of the five expansion slots are available for additional interfaces:

Option 17XXA-008 adds an IEEE-488 interface and an additional RS-232-C serial data port. The 1752A can accomodate up to four IEEE-488 ports.

Option 17XXA-009 is a reconfigurable, dual serial-data port with its own buffer memory. It is supplied configured for RS-232-C with full modem compatibility. Each port can be easily reconfigured for a 20 milliamp current loop, or for RS-422 balanced lines. Up to three -009s may be installed for a total system of seven serial ports.

Option 17XXA-002 (Parallel Interface) gives you two independent 16-bit parallel I/O ports that can function as independent lines, 8-bit bytes, or 16 or 32-bit words. Line protocol is available (but not required), and the sense of the data can be reconfigured to either High true or Low true. A maximum of three modules may be installed for a total of six 16-bit ports.

Options & Peripherals `

RAM Memory Expansion Modules (-006, -007, -016, -017)

Internal program and data space may be expanded to over 3M bytes with RAM expansion options. Memory may be added in the following increments:

17XXA-006 256K bytes
17XXA-007 512K bytes
17XXA-016 1M bytes
17XXA-017 2M bytes

Application programs can assign any part of this memory to function as an "Electronic Disk." Programs and data may be loaded to this E-Disk, allowing faster transfer rates and no disk wear.

Non-volatile RAM Options (-018, -019, -020)

These options provide either 256K bytes (-018), 512K bytes (-019) or 1M bytes (-020) of file-structured, non-volatile RAM memory. Transfer rates are comparable to RAM – over 1M bytes per second. Up to 4M bytes non-volatile RAM may be installed in the 1752A.

Non-volatile RAM is a solid-state medium which is immune to pollution and vibration, making it ideal for harsh environments where floppy disk operation is not practical. Non-volatile RAM is battery backed up for up to five years to retain its file contents through a power loss. Since non-volatile RAM has a much greater tolerance to temperature extremes than other media, the 1722A can operate from 0°C to 40°C when non-volatile RAM is the primary file storage medium. Non-volatile RAM provides a write protection switch to protect its file contents.

Internal Winchester Disk Drive

John Fluke Mfg. Co., Inc. will be introducing an internal Winchester disk drive for the 1752A in April 1989. For further information please contact your local Fluke Sales Engineer or Representative.

External Floppy Disk Drive Systems (1760A and 1761A)

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage. The 1760A and 1761A use double-density dual-head disk drives. The full on-line capacity is 400K bytes for the 1760A, and 800K bytes for the 1761A, including a file directory for each floppy disk. They interface to the 1752A via the IEEE-488 port. Both systems are rack mountable and easy to install and use. Transfer rate is 22K bytes per second. Up to two 1761As can be accommodated, for a total of 2M bytes of on-line floppy disk file space.

External Winchester Disk Drives

The 1765B Series of Winchester disk drives provides high-capacity hard disk file storage for the 1752A Data Acquisition System:

1765B/20 20M byte Winchester Disk Drive
1765B/20M Multi-User 20M Byte Winchester Disk Drive

Both models provide easy connection to the Data Acquisition System through a stand ard IEEE-488 interface, and are rack-mountable, using the optional rack-mount kit. More information is available in the following "disk drive" section.

Floating Point Math Coprocessor

John Fluke Mfg. Co., Inc. will be introducing a floating point math coprocessor for the 1752A in April 1989. For further information please contact your local Fluke Sales Engineer or Representative.

High Speed Data Acquisition and Control

A 1752A option that provides high speed sampling of analog inputs up to 60 kHz is available through Fluke Customer Support Services. This option, called the Multifunction Board, also has the capability of accepting digital inputs and sourcing digital and analog outputs for control of quickly changing parameters.

See a more thorough description of the Multifunction Board in the Customer Support Services section (page 467) and consult your Fluke Account Manager for full details.

Software

The 1752A offers an environment specifically suited to the development of real-time control programs. Interpreted BASIC, Compiler BASIC, FORTRAN, Assembly, C and several utility softwares are available. For more information on 1752A software systems, consult the 1700 Series Software section, following this section. A data acquisition library provides routines directly accessible from BASIC, greatly simplifying data acquisition and control tasks. The “Getting Started” software provides the user with a number of useful programs, allowing the user to access many of the 1752A’s capabilities through the touch screen.

Module-Level Diagnostics

The 1752A is a modular design with diagnostic software that allows semi-skilled operators to identify failures to the module level. Spare-module kits are available for the most time-critical applications. Fluke also maintains an inventory of 1752A modules that may be shipped within hours in most cases, and which can be exchanged for a defective module for a nominal charge. Contact your Fluke Technical Service Center for more information.

Manuals That Make the Task Easy

Experience will tell you that the major investment in an automated instrument system is not usually in the hardware, but in system integration and the development of application software to run it. The quality of documentation is a key consideration. You will find that 1752A manuals are among the most readable, consistent, and sensible software documentation available anywhere. Ask your Fluke Sales Engineer or Representative to let you evaluate the 1752A through its manuals. You will be pleasantly surprised.

Specifications

Option Specifications

Analog Measurement Processor (-010)

Number of Channels: 16 differential or 32 single-ended (single and differential channels may be mixed)
System Capacity: 4 processors, 128 single-ended channels
Ranges: (full scale, each channel) ±1.0158V; ±10.158V; ±65 mA; 4 to 20 mA displayed as 0 to 100% of scale
Resolution: (16 bits) 10V range, 310 µV; 1V range, 31 µV; 65 mA range, 2.07 µA, (15 ohm, 0.04%, 20 ppm TC sense resistor)
Reading Rate: Synchronized Modes-400 channels/s @50 Hz, 480 channels/s @60 Hz, 400 channels/s @400 Hz; Asynchronous Mode 1000 channels/s
Accuracy (90 days): (10 to 40°C operating) 10V range ±(0.02% of reading + 1.24 mV); 1V range ±(0.02% of reading + 248 µV); 65 mA range ±(0.05% of reading + 16.5 µA)
Common Mode Rejection: dc -77 dB; 50/60 Hz, 60 dB
Normal Mode Rejection: Asynchronous mode, 0 dB; internally synchronized, 20 dB; Externally synchronized, 45 dB
Input Protection: To 50V rms without side effects, fuse protected to 240V rms
Connector: Requires two Y1750s

Analog Control Output (-011)

Outputs: Isolated. Four per module. Voltage (-10V to +10V) or current (0 to 20 mA), individually selectable
Resolution: 2 mV (13 bits) or 5 µA (12 bits)
Isolation: ≤30V dc or peak ac, channel to channel
Max Load: ±5 mA in voltage mode; ≤750Ωin current mode
90-Day Accuracy: ±20 mV in voltage mode and ±20 µA in current mode for ambient tempera ture of 18°C to 28°C
Rate: 1000 changes/sec
Connector Option: Use 2400A-110 or -111

Counter/Totalizer Signal Input (-012)

May be used to perform the following measurements: Frequency, period, totalize, tachometer, “A” gated by “B”, and time interval.

Inputs: TTL, Gate 1, Gate 2, Trigger, Count Up, Count Down, Up/Down, Count, Non-Isolated Common, Isolated Common, Isolated Analog Input
Isolation: Both Analog Input and Isolated Common are isolated from the 1752A and/or ground up to 30V and up to 1.0 V/µs maximum slew rate
Frequency Range: 0 to 900 kHz (TTL Input); 10 Hz to 200 kHz (Analog Input)

Period Range
TTL Input: 1.1 µs to 6.7s
Analog Input: 5 µs to 0.1s
Period Resolution: 400 ns

Time Interval Range
TTL Input: 1 µs to 3.82 hr
Analog Input: 2 µs to 50 ms

Time Interval Resolution: 819 µs (≤3.82 hours); 400 ns (≤6.7 seconds)
Totalizer Input Range: Dc to 900 kHz
Minimum Pulse Width: 400 ns
Totalizer Capacity: -8,388,608 to +8,388,607
Connector: 12 conductors, supplied with option (screw terminals)

Parallel Interface (-002)

Data I/O lines terminated with 24008 to +5V, 5000Ω to ground, with diode input protection. Schematics provided with documentation. Up date rate: 3000/s (status output).

General Specifications

Temperature: 10°C to 40°C with floppy disk, operating; 0°C to 40°C without floppy disk, operating. 10°C to 52°C with floppy disk, non-operating; -20°C to 60°C without floppy disk, non-operating
Relative Humidity: 20% to 80%, non-condensing, operating; 8% to 90% non-condensing, with floppy disk, non-operating or 5% to 95%, non-condensing, without floppy disk, non-operating
EMI and RFI Emissions: Tested to FCC Part 15, Subpart J, Class B; VDE 0871, Class B; CISPR 11-1975
Power: 90V to 132V ac or 180V to 264V ac, 47 Hz to 440 Hz. 175W maximum
Size: 13 cm H x 43 cm W x 55 cm L (5.25 in x 17 in x 21.5 in) plus feet
Weight: 14.5 kg (34 lb). Keyboard 1.4 kg (3 lb)
Included: Y1700 Keyboard, power cord, BASIC system disk, diagnostic disk, “Getting Started” manual and disk, System Guide manual, Operator’s manual, BASIC Programming Manual, Data Acquisition and Control Guide, and a pad of 50 display worksheets

1752A

Ordering Information

Models

January 1989 prices

1752A Data Acquisition System (w/one 1752A-010 Analog Measurement Processor)	$7980
1752A-1 Data Acquisition System (w/o 1752A-010 Analog Meas. Processor)	7080
1702A Extender Chassis (Requires 1752A-013)	2260

Options (for above Models)

-002 Parallel Interface	990
-006 256K byte RAM Memory Expansion	1000
-007 512K byte RAM Memory Expansion	1400
-008 IEEE-488/RS-232-C Interface	850
-009 Dual Serial Interface	990
-010 Analog Measurement Processor	990
-011 4 Channel Analog Output	990
-012 Counter/Totalizer	675
-013 Extender Interface	510
-016 1M Byte RAM Memory Expansion	1800
-017 2M Byte RAM Memory Expansion	3200
-018 256K Byte Non-Volatile RAM	1700
-019 512K Byte Non-Volatile RAM	2700
-020 1M Byte Non-Volatile RAM	3700

Language Systems (See page 368)

-200U 1752A System Software Update	150
-201 Assembly Language Development System	1495
-202 FORTRAN Development System	1495
-203 Compiled BASIC Development System	490
-205 Extended BASIC Development System	$ 490
-912 Non-ANSI C Development System	1995
-913 Non-ANSI C Compiler	1495

Software Options (See page 371)

-900 Binder	30
-901 Gabby	195
-902 Touchscreen Toolbox	295
-903 Compiled MenuBASIC	295
-905 Extended MenuBASIC	295
-907 Transport–>PC	450
S1703 Compiled MenuBASIC Development Package	1900
S1705 Extended MenuBASIC Development Package	1900

Peripherals

1020 Touch Control Screen (includes a desk-top enclosure)	1820
1021 Touch Control Screen	1695
1760A Disk Drive System, 400K byte	1950
1761 Dual Disk Drive System, 800K byte	2950
1765B/20 20M byte Winchester Disk Drive	3295
1765B/20M Multi-User 20M byte Winchester Disk Drive	on req
1780A InfoTouch Display	2150

Accessories (Also see page 485)

Y1700 Programmer Keyboard	395
Y1702 RS-232-C Null Modem Cable, 2m	125
Y1703 RS-232-C Null Modem Cable, 4m	150
Y1705 RS-232-C Null Modem Cable, 0.3m	75
Y1706 Certified Blank Disks Unformatted (pkg of 10)	$ 60
Y1707 RS-232-C Interface Cable, 2m	125
Y1708 RS-232-C Interface Cable, 10m	150
Y1709 Printer Cable, 2m	125
Y1717 Parallel Interface Cable	150
Y1750 Input Terminal Block w/Cable	60
Y1751 Replacement Cable Set for Y1750	65
Y1752 Line Frequency Sync Transformer	50
Y1790 Rack Mount Kit w/24" Slides	195
Y1791 Rack Mount Kit for 1780A (requires slides)	95
Y1795 Portable Carry Handle	48
M00-260-610 18" Rack Slides	130
M00-280-610 24" Rack Slides	130
Y8021 Shielded IEEE-488 Interface Cable, 1m	130
Y8022 Shielded IEEE-488 Interface Cable, 2m	145
Y8023 Shielded IEEE-488 Interface Cable, 4m	155

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1752A Repair (w/calibration)	282
SC1-1752A Repair (cal w/in or out data)	317
SC1-1752A Repair (cal w/in and out data)	352
SC2-1752A Cal (1 per yr recommended)	63
SC2-1752A Cal (1 per yr w/in or out data)	98
SC2-1752A Cal (1 per yr w/in & out data)	133

2452MCS

GPIB IEEE-488

2452MCS

2452MCS Measurement & Control System

- Complete system – combines 2400B Intelligent Computer Front End, 1752A Data Acquisition System, and software
- Extensive selection of I/O options – expandable to over 1000 channels with 2401A and 2402A extender chassis
- Touch Screen – friendly operator interface with graphics
- "Multi-computing" – 2400B handles scanning, linearizations, limit checking and direct control of test or process. 1752A downloads and modifies 2400B program, retrieves scanned data, formats and outputs reports, and provides operator interface
- Available with or without 28 inch high cabinet
- Choice of GPIB/IEEE-488 or Serial (RS-232-C, RS-422) Interfaces

The 2452MCS is a fully integrated measurement and control system which combines the power of two intelligent Fluke instruments – the 1752A Data Acquisition System and the 2400B Intelligent Computer Front End. The system is housed in a locking cabinet that fits on either a work bench or separate stand and includes all the hardware, cables, drawers, etc., necessary to combine the 2400B and 1752A into a complete measurement and control system. Alternatively, the 2452MCS may be ordered without a cabinet to be mounted in your own rack or panel.

The 2400B provides digital and analog measurement, signal conditioning, control outputs, and intelligent decision making, while the 1752A provides tremendous computing power, high speed data acquisition, a CRT display with a touch-sensitive overlay, advanced graphics capabilities, and mass storage via a double-sided floppy disk. Both instruments work together, sometimes independently, sometimes cooperatively, providing a multi-computing system with the power and flexibility to expand as your application requirements increase.

The programmer's keyboard is placed on a convenient sliding rack drawer that may be locked to prevent unauthorized program modification. The system can be programmed to allow the touch-sensitive CRT display to be the operator's interface. This reduces operator errors and training time because the operator interacts with a friendly CRT display customized for the application and written in familiar words.

The 2452MCS, when equipped with the 2400B's Serial interface, permits the 2400B to be located up to 1220 meters (4000 feet) away from the 1752A. A distributed data acquisition system may be constructed in this manner using a single 1722A or 1752A and multiple 2400Bs, in either star or "daisy chain" configurations.

The basic 2452MCS System includes the software tools, and hardware necessary to make it operate as a ten-channel data acquisition system. The system is expandable to sixty channels in the basic 2400B mainframe and to over 1000 channels by adding 2401A and/or 2402A Extender Chassis and intput/output options.

Input/Output Capabilities

The measurement of analog inputs such as thermocouples, RTDs, strain gages, dc and ac voltages, and currents can be performed by a 17-bit A/D converter in the 2400B. Capable of resolving 1 μV, the highly accurate A/D conversion preserves data integrity through a sophisticated noise rejection technique that synchronizes its measurement period with the power line frequency. For high speed measurements, analog inputs can be brought directly in to an optional analog measurement processor in the 1752A for 14 bit resolution at 1000 readings per second.

Digital inputs accommodated by the 2452MCS incude status, contact closure, interrupt, BCD, pulse, frequency, totalizing and sequence of events.

2452MCS

Controlling outputs sourced by the 2452MCS consist of voltage, 4-20 mA current, resistance, stepper motor control, TTL outputs, and relay closures. A complete description of input/output capabilities is found in the pages describing the 2400B.

Software Options Included

Software supplied with the system includes a program development package ("ProLink II'", an enhanced BASIC interpreter with extended graphics capabilities, an advanced Editor, and a File Utility Program. The 2452MCS -03 and -04 also include the ProComm software package. (ProLink II and ProComm are both described in a section immediately following the 2452MCS description.) This complete package provides the tools necessary for a programmer to create a custom tailored data acquisition program.

If you want to "come up to speed" and write your application program in a hurry, consider the ProGen Application Software (S2452) package described on the following page. Alternatively, Fluke can help with training classes held either at our offices or at your site. We can also arrange for one of our in-house experts to assist you personally in creating your application-solving software.

Turnkey Systems

Fluke Customer Support Services System Integration group and Fluke Cooperative Services (FCS) are available to write custom application software and combine with Fluke hardware for a complete system. In fact if a turnkey system is what you require, Fluke has a list of Fluke Cooperative Service partners that are experienced with Fluke equipment and capable of fulfilling your needs in several unique industry segments.

Information on training classes, Customer Support Service and FCS is available from your Fluke Sales Representative.

Specifications

For complete specifications please refer to the pages in this catalog describing the 1752A and the following pages that describe the 2400B.

CRT Display: High contrast green phosphor, high resolution, 5x9 inch display screen. Sixteen lines of eighty characters or eight lines of forty characters, selectable by program control.

Transparent Touch-Sensitive Overlay: Positioned directly over the display screen. Provides a 6x10 array of touch-sense areas for dynamic operator interface.

Graphics Display: 640 by 224 dots, hardware sector generator.

Memory, 1752A: 136K bytes of RAM (expandable to over 2.6M bytes).

Memory, 2400B: 28K bytes of RAM for program storage.

Mass Storage
- Double-sided 5-1/4 inch floppy disk stores 400K bytes
- 800K bytes more with dual floppy disk drive (optional)
- 20M bytes with Winchester Disk (optional)

1752A Communications Interfaces: One IEEE-488 port and one RS-232-C port is standard. May be expanded to include six additional RS-232-C, RS-422, and/or 20 mA serial ports or a second IEEE-488 pport

2400B Interfaces: Three. One IEEE-488 port or one serial (RS-232-C, RS-422, or 20 mA) port, and two RS-232-C output-only ports.

Temperature: 10°C to 30°C, operating; -10°C to 60°C, non-operating (except floppy disks limited to 10°C to 52°C.

Relative Humidity: 5% to 80% operating, non-condensing; 5% to 95%, non-operating and non-condensing (except floppy disks limited to 8% to 90%).

Power: 90 to 132V ac or 180 to 264V ac, switch-selectable, 50 Hz to 60 Hz, ±2 Hz.

Size: 70.6 cm H x 61.0 cm W x 70.5 cm D (27.8 in x 24 in x 27.8 in)

Weight: 84 kg (185 lb) approximately, not including options.

2452MCS System Components:
- 1752A-1 with Keyboard
- Fluke enhanced BASIC Interpreter, Advanced Editor, File Utility Program
- ProLink II application software package (see page following for description)
- ProComm application software package (-03, -04 only) (see page following for description)
- 2400B with one each of Option -101, -102, -109, and -002 (or -001)
- Integral power strip and power cord
- Full set of Operator and Service Manuals
- 90-day on-site service

Model & Version	Rack Cabinet 71 cm (28") High	2400B Interface & 2 Meter Cable
2452MCS-01	Yes	IEEE-488 (Opt -002)
2452MCS-02	No	IEEE-488 (Opt -002)
2452MCS-03	Yes	Serial (Opt -001)
2452MCS-04	No	Serial (Opt -001)

The rack cabinet has a lockable storage drawer and keyboard drawer, a rear door, and associated hardware.

Ordering Information

Models

January 1989 prices

2452MCS-01	$14,800
2452MCS-02	$14,400
2452MCS-03	$14,800
2452MCS-04	$14,400

Options

See 2400B, page 421 and 1752A page 415.

Accessories (Also see page 485)

A24-89 71 cm Instrument Rack (28")	on req
A24-75 183 cm Instrument Rack (6')	on req
A24-90 Wheeled base, for A24-89 or A24-75	on req
A24-123 Serial Impact Printer w/RS-232-C I/F	on req
Y2055 15-Pin Multi-Connector for Multi-Drop RS-422 Hook-up ("Y" Connector)	95
1765B/20 20M-byte Winchester Disk Drive	3295
1761A External Disk Drive, 2x400k bytes	2950
1760A External Disk Drive, 400K bytes	1950

Service & Support

Warranty

90-day on-site product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2452MCS Repair (w/calibration)	1092
SC1-2452MCS Repair (cal w/in or out data)	1127
SC1-2452MCS Repair (cal w/in and out data)	1162
SC2-2452MCS Cal (1 per yr recommended)	207
SC2-2452MCS Cal (1 per yr w/in or out data)	242
SC2-2452MCS Cal (1 per yr w/in and out data)	277

ProLink II Application Software (S2400)

- Supplied with all 2452MCS Systems
- For use with Fluke 1722A/1752A and 2400B
- Simplifies development of 2400B application program
- Menu-driven user interface

Measurement & Control Software

Fluke offers a wide range of application software to help you develop your 2400B program.

Three of these software packages are designed to be used with the 2452MCS. They are Fluke ProLink II™ Application Software, ProComm™ Serial Communications Utility Package, and ProGen™ Application Software Package.

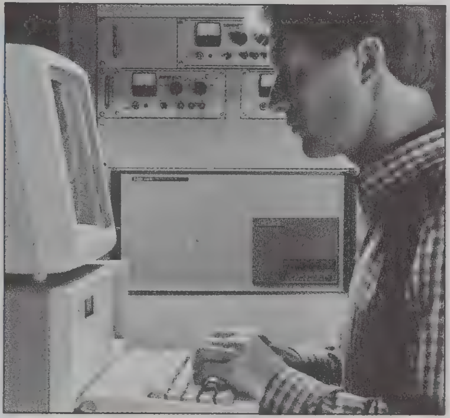
A fourth software development tool, ProLink PC,™ runs on your IBM PC,™ PC XT,™ or IBM compatible.

Fluke ProLink II Application Software comes standard with all 2452MCS systems. It is a tool which makes developing 2452MCS application program easier.

The 2452MCS consists of two independent computers: the Fluke 2400B and the 1752A Data Acquisition System. These two computers must talk to each other in order to do the job. Fluke ProLink II handles a lot of the system housekeeping tasks you would otherwise have to do. It presents you with a single user interface to both the 1752A and 2400B.

ProLink II presents the user with a menu of choices. You simply move the cursor to the proper selection and press the carriage return. This "one-touch" approach lets you do the following:

1. Automatically run Fluke BASIC; the File Utility Program which allows you to copy, move, delete or otherwise manipulate files; and SET, which allows you to set the RS-232C characteristics of the 1722A/1752A output ports. After exiting any of these three programs, you will automatically be returned to ProLink II.
2. Sends bus commands to the 2400B and displays responses to those commands.
3. Displays English language error messages if an error occurs.
4. Select, edit, download or retrieve user written 2400B programs.
5. Monitor selected variables during program execution. This function is very useful during the program debugging stage. You can download and run your 2400B program, and then monitor certain key variables. In this way you can ensure that variables are changing as you expect them to.
6. Print a hard copy of any file on an external printer.



ProComm Serial Communications Utility (S2417)

- Supplied with 2452MCS-03 and -04
- For use with 1722A/1752A and 2400B equipped with 2400B-001 serial I/F
- Implements serial communications between 1722A/1752A and 2400B, or multiple 2400Bs to single 1722A/1752A
- Provides built-in error detection and recovery capability
- Supports communications via modems as well as "hard-wired"

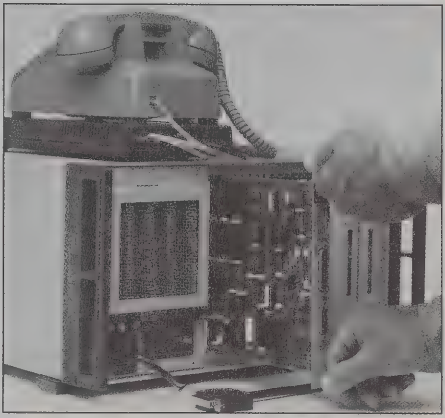
ProComm™ Serial Communications Utility Package comes standard with both serial versions of the 2452MCS, -03 and -04.

ProComm software is a utility package which implements serial communications between the 1722A/1752A and the 2400B Front End. The subroutines are callable from BASIC.

There are three functions which ProComm software can provide for you. If you are using an RS-422 or current loop transmission line, you can have more than one 2400B connected to your 1722A/1752A. This is called a multipoint system. ProComm software allows you to address and unaddress (terminate communications with) each 2400B in your system.

Second, ProComm software implements the highest level message transfer protocol supported by the 2400B, blocked format with acknowledgements and check character. This message transmission protocol provides your communications link with built-in error detection and recovery capability. It is especially useful in electrically noisy applications, or where you must guarantee the integrity of your data.

Third, if you are using a 2400B with an auto-answer modem across an RS-232C interface, ProComm software will automatically hang up the phone line on demand.



ProGen Application Software (S2452)

- For use with 2452MCS Systems
- Menu-prompted monitoring/controlling/logging program
- Requires no language programming knowledge to operate
- Supports up to 500 channels of input/output

ProGen Application Software allows user to get up and running quickly with the 2452MCS. It is a menu-prompted tool which actually programs the 2452MCS for you. Your 2452MCS can be monitoring and controlling your process or test in a short time.

ProGen software is compatible with all versions of 2452MCS, serial or IEEE-488. A 17XXA-007 512K byte RAM expansion option must be installed.

Fluke realizes that there may be one person who programs the application, and another who operates it. Accordingly, ProGen software has two separate disks: Programmer and Operator.

The person responsible for configuring the 2452MCS to meet the application uses the Programmer disk. This disk, in turn, creates the Operator disk.

The programmer is prompted to either "fill-in-the-blanks" or use the cursor control keys to move the cursor to the proper choice. Up to 500 channels can be monitored and controlled. In addition, you may select one of up to 100 user-defined limits lists of four limits each to apply to each channel.

The operator can change only those limits and setpoints which the programmer allows. The opdata, some data, or alarms only. Alarm data is automatically recorded.

ProGen software is the easy way to get your 2452MCS up and running.

Measurement & Control Software

ProLink PC Application Software (S2401)

- For use with IBM PC and Fluke 2400B Intelligent Computer Front End (serial communication)
- Simplifies development of 2400B measurement and control program
- Menu-driven user interface

ProLink PC is a menu-driven tool for developing 2400B programs with an IBM PC,™ PC XT,™ or IBM compatible. Similar in scope and function to ProLink II software, ProLink PC software will handle the communications between the two computers.

Your IBM PC must have an optional serial interface installed. Since the PC XT has this interface standard, ProLink PC software will operate directly on the XT. MS-DOS™ version 2.1 or higher is required.

The operator interface operates similar to ProLink II. The user is presented with a menu of choices. These choices allow you to do the following:

1. Set the RS-232C characteristics of the IBM communications ports.
2. Select, download, or retrieve 2400B programs.
3. Sends bus commands to the 2400B and display responses to those commands.
4. Displays English language error messages if an error occurs.
5. Monitor selected variables during program execution for program debugging.
6. Print a hard copy of a file on an external printer.
7. Exit ProLink PC to the IBM's operating system. The user can then use the editor EDLIN to edit his 2400B program.
8. Automatically set the date and time in the 2400B.

ProLogger 24 Application Software (S2402)

- For use with IBM-PC and Fluke 2400B Intelligent Computer Front End
- A program development tool and a data acquisition program

ProLogger 24 is a communications utility and a data acquisition program for the IBM Personal Computer and the Fluke 2400B.

As a communications utility this tool assists in the development of a 2400B program. It includes error decoding, downloading and retrieval of the program, a line editor for program modification, bus command interaction and real time block graphic display of a 2400B channel or variable.

As a data acquisition program it provides the ability to print and record to the IBM disk 2400B data. The data can be recorded as sent from the 2400B or in LOTUS 1-2-3™ format.

The key to the use of ProLogger 24 is the user defined macro. Macros are a series of 2400B bus commands that are executed on interval or on demand. ProLogger 24 can receive, display, record or print 2400B data. Data may be checked against limits. If a limit is exceeded the macro can execute another bus command, branch within the macro or trigger another macro. An alarm indicator flashes for unacknowledged alarms. An alarm transition log and an alarm status report is avail-able to the operator.

The IBM-PC, XT, AT or compatable must have a serial interface and MS-DOS 2.1 or higher. A color monitor is not a necessity, but will enhance the appearance of ProLogger 24. The IBM-PC needs 128K of memory, however, LOTUS 1-2-3™ will require additional memory. The 2400B option -001 and a serial cable.

ProLogger 24 allows full use of the 2400B stored program capability if desired.

Ordering Information

Software Packages

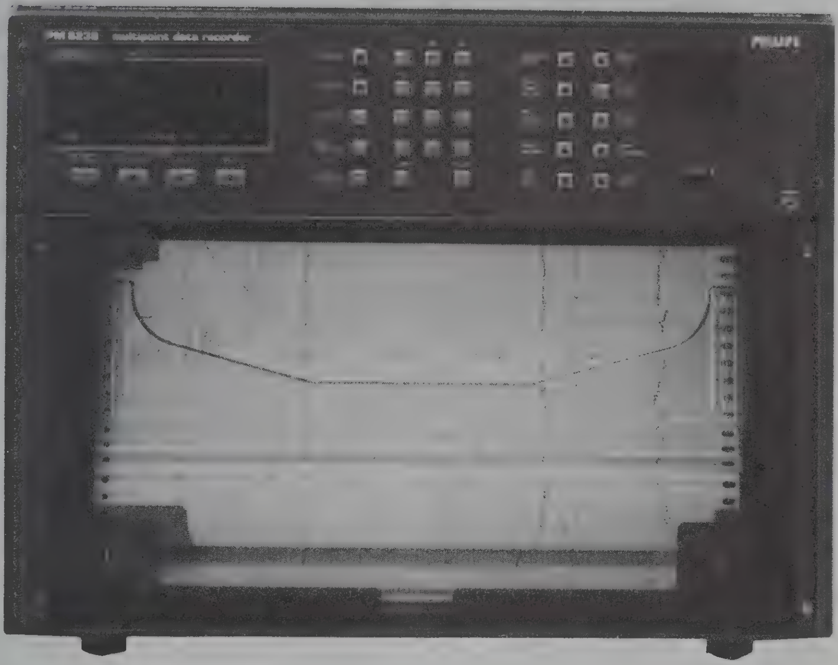
S2400* ProLink II Application Software for 1722A/1752A	$295
S2401 ProLink PC Application Software for MS-DOS	295
S2402 ProLogger 24 Application Software for MS-DOS	295
S2417* ProComm Serial Communications Package for 1722A/1752A	295
S2452 ProGen Application Software for 1722A/1752A	495

**Included with all 2452MCS Systems*
***Included with 2452MCS-03 and -04*

PM 8238

GPIB
IEEE-488

NEW



PM 8238

PM 8238 Multipoint Data Recorder

- Maximum 30 input channels, scanned at 10/s
- Graphic or numeric data presentation
- Optional alarm output plug-in cards
- Interpolation between measuring points for continuous line-plots
- Memory modules for user-program storage
- AX + B scaled measurements
- Maintenance free thermal printing

The PM 8238 is a 30 channel data recorder of the highest quality and reliability and is specifically designed to be set and left running for extended unattended operation. It offers real measurement versatility with features such as memory modules, which allow storage of settings. It can directly record voltage or temperature, with a wide choice of sensors in 2- or 4-wire configurations. Scanning takes only 100 ms/channel, for quick alarm detection. Individual measurement values are presented on a front-panel display: chart output can be numeric for clear presentation of values; graphic, for spotting trends; or both in combination.

Dependable Plotting, Durable Construction

The PM 8238 has been designed and constructed to give the highest quality and reliability in operation. Very reliable low noise reed relays are used for channel switching. The relays are tested to three times the normal operating life of the instrument. The number of components and PCBs is less than in similar instruments and the wiring has been reduced, cutting the chance of instrument failure; and special attention has been given to a rugged, durable construction. Quality and reliability is such that a high MTBF has been achieved.

Printing is by a high quality, maintenance free thermal print head. The user does not have to change pens, replace ribbons, fill ink reservoirs or clear inkjets. The head is virtually unaffected by dusty environments, ensuring sharp, quality plots throughout the life of the instrument.

To match the quality and reliability, the PM 8238 offers high accuracy and has a very broad spectrum of functions.

Systems Use

This instrument is ideally suited for unattended, preprogrammed operation, where the reliability is of maximum benefit. With optional IEC-625/IEEE-488 (GPIB) or V24/RS 232-C interfaces, operation in a computer controlled environment is possible. These allow various functions such as output of measured values to a computer/controller, remote control and set-up, presetting and programming and synchronized measurements. An optional extended TTL-control interface card provides remote control of some other functions such as chart speed, scan start, channel changing and printing event markers, all via TTL level signals. At any time, a complete survey of parameters can be requested.

Comprehensive Presentation Capabilities

The full scale definition of 1000 dots represents a resolution of 1 µV over the 250 mm (10 in.) plot width (at 1 mV span). Each channel is stamped with its number and the plots are date and time stamped if required, allowing easy archiving and copying of plots for distribution. Measurement speed is such that all 30 channels are scanned in 3s; this makes the PM 8238 ideal for real-time monitoring and control of many variables; it also provides for quick reactions to alarms. Because of the high speed, it can also be used for monitoring cause and effect on adjacent channels and for most applications, the plotting on such channels may be regarded as simultaneous. Charts are plotted on standard z-fold 250 mm (10 in.) wide thermal paper.

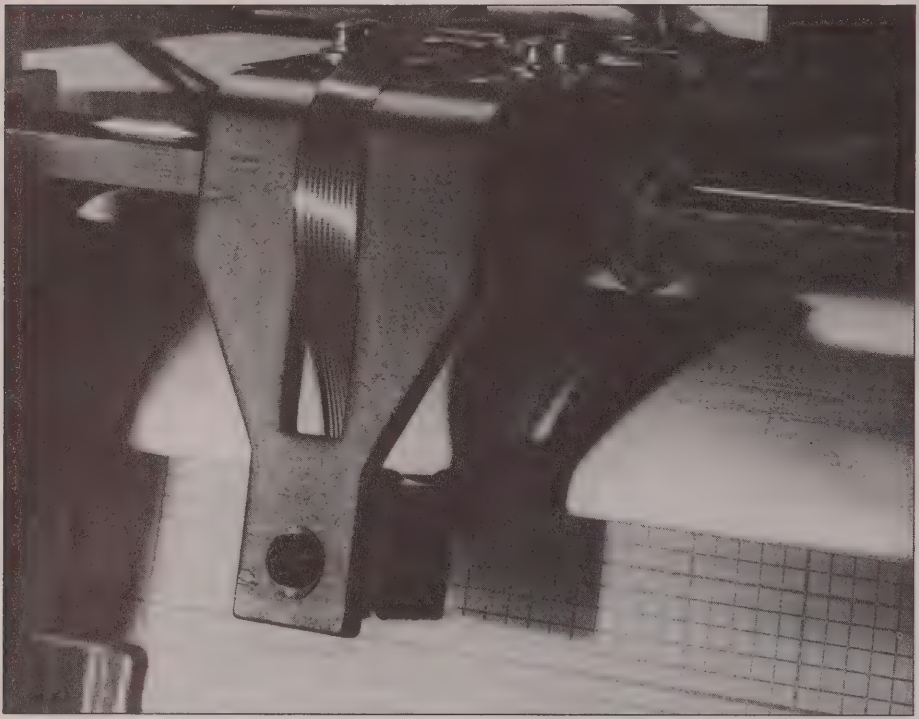
The AX + B scaling function allows display of the appropriate range for the variable: for example when operated with a humidity sensor, instead of displaying the mV output, that channel can be scaled to read from 0...100%.

In standby mode, input from the front panel or from a controller in a system set-up is directly recorded on the chart. Other information recorded on the chart includes chart speed; temperature at the isothermal input block for cold junction compensation; alarm points; functional units - V, °C or scaled; and the time of unexpected events such as power interruption. Dot density is alterable for each channel if the operator wishes one to be highlighted.

Numeric or Graphic Mode

Numeric mode directly outputs the values of individual measurements, in a 10-column tabular form, and this mode can be instantly selected at any time while recording. It can also

PM 8238



print out automatically, at user defined intervals of one minute from 1 to 99, allowing quick overviews of actual measurement results. Printouts include codes to show fault conditions such as out-of-scale, under-scale, thermocouple break or alarm conditions met.

Graphic mode gives optimum interpretation of results. It has a switchable interpolation mode that fills in dots between the actual measurement points. This gives continuous line plotting for direct detection of trends, peaks and irregularities. The fast measurement time (100 ms/channel) ensures the user can interpret events virtually in real-time. Comprehensive zero suppression facilities permit a flexible choice of scale positioning, so together with a chart speed continuously variable over 60 mm/min to 60 mm/h, optimum use is made of printout area. Multiple readings in the same range can be re-scaled for immediate comparisons. Direct plots can also be automatically made of the difference in measurements on different channels, speeding up comparisons and eliminating the potential for calculation error. A numeric print out can be selected automatically, while in graphic mode, at user defined intervals in steps of 10 minutes.

Simple Yet Versatile Operation

No previous knowledge of the instrument, or knowledge of software or programming are needed to operate this instrument. All tasks such as linearization and mixing of variable measurements on different channels are automatically handled by the recorder. PM 8238 can handle any combination of voltage or 2- or 4-wire temperature measurement on the maximum 30 channels (15 for 4-wire operation). Parameter settings are entered directly at the instrument keyboard, or from a remote PC or controller via one of the systems interfaces. All function keys have an LED to indicate activation. Keyboard settings are lockable to prevent accidental changes.

Programming is simple, via front panel keystrokes and clear error messages are provided. The range of possibilities for unattended operation is extended by the programming modules which can store settings. There is even a "copy channel" function for fast repeat programming.

Voltage Measurements

Choice of voltage ranges up to a maximum of ±30 V, with spans of 1 mV to 30V. The zero suppression facility allows the span to be located as a window over the selected range, and is entered by typing in the zero- and full-scale values of the window.

Temperature Measurement

Pt 100 uses the 4-wire connection, eliminating errors due to wire resistance; and the low 0.77 mA source current prevents self-heating.

For thermocouples three different forms of cold junction compensation are provided:

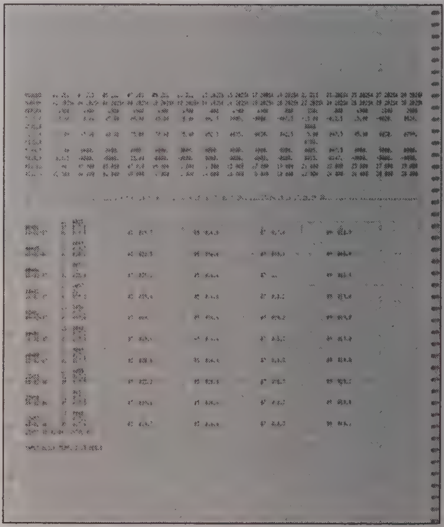
- automatic
- fixed at 0°C, 20°C or 50°C
- compensation from any other channel, eliminating the need for long compensation wires if the instrument is not near the measurement point.

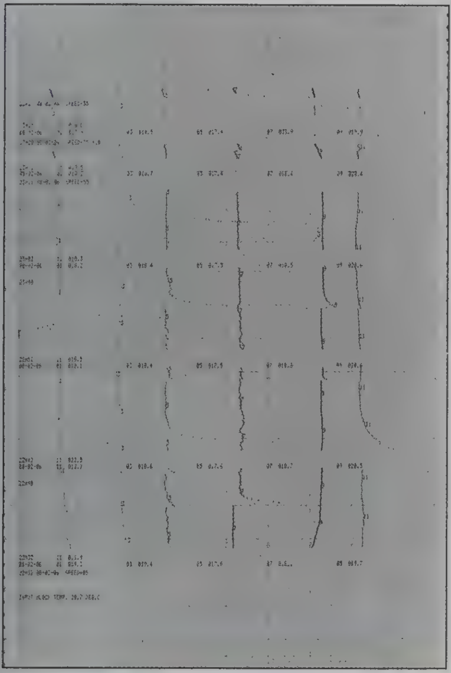
Cold junction compensation is achieved by a built-in isothermal block ensuring $<{}^{1}/_{4}$°C difference between terminals. The block is in a lockable compartment at the back, to protect it from any external effects such as direct heat radiation or convection. The difference measurement facility also helps eliminate cold junction errors; it automatically calculates the difference in readings been two channels, greatly reducing this type of inaccuracy (common to two channels).

Linearization is automatic for the 4 most common thermocouples: J-, K-, S- and T-type, with options for R-, B-, E-type, Nicrosil/Nisel and Ni-Ni. The zero suppression facilities described in the voltage measurement section are also available for temperature measurement. Error messages alert the operator if something goes wrong such as a break in thermocouple connection.

Alarms

The alarms may initiate one of several responses: e.g. increasing line intensity, print only on alarm or vary the chart speed. The PM 8328 unit provides for a maximum of two alarm cards to provide several alarm combinations. Slot 1 provides one minimum alarm and one maximum for odd numbered channels; slot 2 the same for even numbers. The cards simply plug-in and two common contacts for min/max values are provided.





Specifications

Technical Specifications

Voltage Measurements

Ranges and Spans:

Func-tion	Permitted span	Full- and zero-scale limits	Range
mV	1...30 mV	-30...+30mV	30 mV
	5...300 mV	-300...-30 mV +30...+300 mV	300 mV
	50...3000 mV	-3000...-300 mV +300...+3000 mV	3000 mV
V	0.5...30 V	-30...+30 V	30 V

Accuracy: ±0.1% of input value ±0.1% of span
Temp. Coefficient of Accuracy: 0.2% of the input value per °C

Input:
Input Offset Voltage: <5 µV (= 1.25 mm at span of 1 mV)
Input Offset Voltage Drift: <0.5 µV/°C
Input Current: <100 pA
Input Impedance: 10 MΩ
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Possible Input Configurations: 2- and 4-terminal
Common Mode Rejection Ration (CMRR): >132 dB for DC
Series Mode Rejection Ration (SMRR): >38 dB for 50 and 60 Hz ± 1%
Measurement Time: 100 ms per channel

Thermocouple Measurements

Thermocouple Types:
J-type (Fe-Const)[1]
L-type (Fe-Const DIN)
K-type (Chromel-Alumel[1] + DIN)
S-type (Pt-Rh 10Pt[1] + DIN)
T-type (Cu-Const[1])
U-type (Cu-Const DIN)

[1] IEC 584-1, IPTS 68

Ranges and Spans

Type	Permitted span	Full- and zero-scale limits °C (see note)	Range
J, L	25...700	-200(-50)...+500	500
	250...850	-100(-20)...+705	750
K	30...900	-200(-50)...+700	700
	300...1470	-100(-20)...+1370	1370
S	250...1600	0...+1600	1600
T, U	35...600	-200(-50)...+400	0400

Note: The minimum input temperature above which full resolution (100 points) is obtained at the minimum span is indicated between brackets.

Accuracy (excl. Thermocouple): basic accuracy ± cold junction contribution ±0.1% of span

Basic Accuracy (over rated temp. range):

Type	Range	Basic Accuracy
J, L	500°C	±0.1%, T_{in} ±0.2°C (±0.55°C, T_{in} <50°C)
	750°C	±0.1%, T_{in}±0.3°C (±0.4°C, T_{in} <-20°C)
K	700°C	±0.05%, T_{in} ±0.35°C (±0.75°C, T_{in} <-50°C)
	1370°C	±0.1%, T_{in} ±0.7°C (±0.8°C, T_{in} <-20°C)
S	1600°C	0.1% T_{in} ±1.3°C
T, U	400°C	±0.1%, T_{in} ±0.3°C (±0.6°C, T_{in} <-50°C)

Cold Junction Contribution: ≈ 1.2 x cold junction

Cold Junction Accuracy:
Measured Internally (Automatic): ±0.45°C ± 0.02(T_{amb} - 23)°C
Measured Externally (in Channel NN): Accuracy of external channel NN
Fixed (at 0°C, 20°C or 50°C): accuracy of external supplied temperature
Input Configurations: 2- and 4-terminal
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Measurement Time: 100 ms per channel

PT 100 Measurements

Pt 100 Temperature Measurement Current: 0.7685 mA
Span: 25...1050°C (span is the difference between the selected full-scale value FSV and the selected zero-scale value ZSV)
Full- and Zero-scale Limits: -200...+850°C
Accuracy (excl. Transducer): ±0.10% of T_{in} ± 0.25°C ± 0.06(T_{amb} - 23)°C ± 0.1% of span
Linearization: Acc. to DIN 43760/BS 1904: 1964
Input Configuration: 4-terminal input
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Measurement Time: 100 ms per channel

Resistance Measurements

Transducer Resistance: 0...3.9kΩ
Measuring Current: 0.7685 mA
Accuracy of the Current: ±0.015%
Temperature Coefficient of Current Source: 0.005% per °C
Input Configuration: 4-terminal

Differential Measurements
A channel X can be programmed to measure the difference relative to another channel Y

Alarm Relay (in PM 8238 and PM 9895)

Contact Ratings:
Switched Power: 10 W max.
Switched Voltage: 45 V_{DC} or 30 V_{AC} max.
Maximum Voltage between Contacts and Earth: 42 V_{DC} or 30 V_{AC} (rms)
Alarm to Contact Closure Time: depends on number of measured channels
Current through Closed Contacts: 2 A, DC or AC (rms) max.
Contact Resistance: 50 mΩ

General Specifications

Mains Voltage (Factory Set): 220...240 V_{AC} ± 10%; 110...127 V_{AC} ± 10%
Mains Frequency: 50 Hz ± 5% (can be set to 60 Hz)
Electrical Safety: Acc. to IEC 348 class 1; VDE 411 class 1
Dimensions (h x w x d): 284 x 352 x 444 mm (incl. feet)
Weight: Approx. 13 kg.
Climatic Conditions: Acc. to IEC 359, C1 tested acc. to IEC 68
Rated Temperature Range: operation within spec, +5...+50°C; limits of operation, 10...+50°C
Humidity: 20...80% RH non-condensing
Max. Dewpoint Temp: 26°C
Storage and Transport: Acc. to IEC 359; temperature -40...+70°C
Reference Conditions: Acc. to IEC 359; temperature 23°C ± 2°C; humidity 45...75% RH
Warm-up Time: 30 Minutes

Resolution:
Recording in Dot Mode: 0.1% of span (1000 points)
Recording in Numeric Mode: absolute value of the measured input with signal printed to four digits
Displayed Value: absolute value of the measured input with signal indicated to four digits.

Included with the instrument:

- package of 5 books of folded thermo-sensitive paper (20 m each), black imaging
- 2 fuses 1.6 A-T
- mains cord
- paper output tray
- program module
- operating manual "PM 8238 Multipoint Data Recorder"
- operating manual "PM 8238 Interfaces to other devices"

KS 8238 Industrialized Configuration

This multipoint recorder comes in two mainframe versions. The PM 8238 is designed for laboratory/bench top environments while the KS 8238 is designed for more industrial/systems environments. Both mainframe versions use the same internal hardware and software components. They differ only in packaging. The KS 8238 comes with all of the hardware necessary to panel mount standard. It also has a locking, gasketed front panel that covers the entire front of the instrument. This makes it more impervious to dusty and dirty environments as well as providing additional security against operator error. The KS 8238 also does not have a main power switch to make it easier to slave it off of the system power.

Ordering Information

Model

January 1989 prices

PM 8238/013 30 Channel Multipoint Recorder	$5500
KS 8238/013 30 Channel Multipoint Industrial Configuration Recorder	5950

Accessories

PM 9141/02 3 Program Modules	$175
PM 9838/20 19 inch Rackmount Unit	140
PM 9890/02 RS 232C/V24 Interface	800
PM 9891/02 IEC-625 Interface	950
PM 9893/01 Extended Control Interface	350
PM 9895/02 Alarm Relay Card for 15 channels	525
PM 9930A/03 5 books Z fold Paper, length 20m	90

Additional Thermocouple Linearization Units

PM 9897/03 Type R (0...1765C)	450
PM 9897/13 Type B (250...1820C)	450
PM 9897/23 Type E (-200...400C)	450
PM 9897/33 Type E (-100...1000C)	450
PM 9897/43 NiCrSi/NiSi (0...800C)	450
PM 9897/53 NiCrSi/NiSi (0...1200C)	450
PM 9897/63 Ni/Ni, 18% Mo (0...1400C)	450

Cables

Y1707 2m Cable for RS 232C	125
Y1705 RS 232C Null Modem Cable	75
Y8022 2m Cable for IEEE-488	145

Service & Support

Warranty

One and a half year warranty. (See page 470 for further information on warranty terms and conditions).

Note: The above configurations meet North American requirements. For other power options see page 491.

Operator Interfaces

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Fluke Touch Control Screens (TCS) are sophisticated operator interfaces for computer-based machinery or systems. With a minimum of training, operators can accurately and efficiently control even the most complex systems simply by touching the screen.

Our Touch Control Screens are used as the primary operator interface in applications such as production test systems, machinery control, and with bar code readers in data collection systems. In addition, many original equipment manufacturers of semiconductor fabrication machines, automated test equipment, and heavy industrial metal stamping presses use Fluke Touch Control Screens.

High reliability, rugged packaging, and ease of integration are just a few of the reasons manufacturers are choosing Fluke Touch Control Screens as their operator interface in harsh industrial environments.

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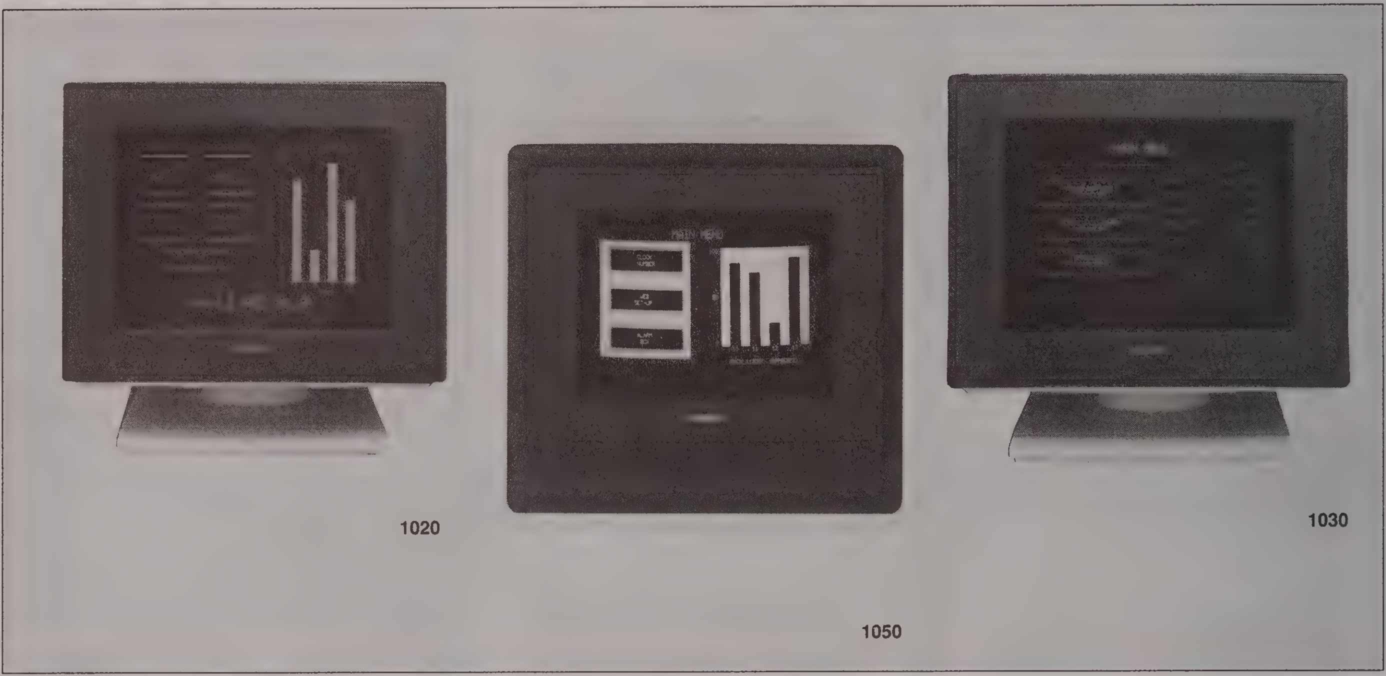
Touch Control Screens



Touch Control Screens eliminate confusing sequences and memorization required by traditional control panels and terminals. Instead, they present a list of options to save training time and cost. Powerful built-in firmware makes these units simple to integrate into any computer-based machine or system.

The Fluke Touch Control Screen (TCS) offering is composed of three product series: The 1020 Series, the 1030 Series, and the 1050 Series. In addition, three software development packages are also available, ScreenBuilder™, IconBuilder™ and Touch Control Screen Toolbox™. The 1020 Series is a fully-integrated subsystem providing the benefits of touch control at a low price. The 1030 Series is a more advanced TCS offering Total Display Memory™ and the ability to multidrop 32 units on a single host serial port. Lastly, the 1050 Series provides all the high level functionality of the monochrome 1030 in a 12" color display.

Each series of products has a durable touch sensitive front panel, CRT, logic board, power supply, and mounting hardware. They are resistant to vibration and shock and sealed against moisture and dirt so they perform reliably in rugged environments. Based on over a decade of touch control experience, these screens bring the latest in technology to OEM applications and inhouse turnkey projects.

High Reliability, Low Cost, Operator Interfaces

- Touch Panel consists of 120 touch cells (12 x 10)
- Advanced programmiong commands
- Rack mountable
- Optional NEMA 12 panel mounting kit
- Selectable character attributes-highlight, blinking, reverse video, underline, conceal (or any combination of these)
- High contrast 12" CRT
- Full one year warranty
- OEM and quantity discounts

Touch Panel

The Touch Panel consists of transparent, conductive polyester sheets that form a switch matrix of 120 touch cells, each 2 lines high by 8 characters wide.

For increased resistance to chemical attack and abrasion, the touch panel is coated with a hardened anti-glare surface. The touch panel has been successfully tested to over 1 million touches.

Mechanical Integration

Mounting the TCS is as simple as cutting a hole, tightening mounting clips, and attaching the cables. For applications that require a drip-proof, dust-tight seal, a NEMA 12 Panel Mounting Kit is available. For easy installation in a standard 19" instrument rack, rack mount kits are also available.

Safety & EMI Standards

The Touch Control Screen is designed to comply with the following safety standards:

- ANSI/UL 478
- IEC 348
- IEC 435
- CSA 556B

The TCS has been verified to comply with the following EMI standards:

- FCC Part 15 Subpart J Class B
- VDE 0871

Diagnostics

Extensive diagnostic and self-test routines ensure the reliability of TCS operations. Whenever the TCS is powered-up or reset, an automatic self-test of ROM, RAM, non-volatile memory and touch panel ensures the integrity of its components.

1020 Series

1020 Series

The Fluke 1020 Series Touch Control Screens (TCS) are low price, menu-based operator interfaces for industrial applications. The Fluke 1020 and 1021 are both fully integrated subsystems. The Model 1020 includes a desk-top enclosure, a complete manual set, and an optional tilt-swivel base and amber display. The 1021, mountable into a panel or rack, can be installed with a NEMA 12 seal for use in harsh environments. The 1021 can include a fan for extending its operating temperature range.

Software Integration

The enhanced command set of the 1020 Series yields flexibility and programming ease. Region commands allow the programmer to create rectangular "touch targets" in a single command. Other commands allow the host to erase an entire region or modify the attributes within it. Characters can be displayed in reverse video, highlighted, blinking, underlined, or any combination of these. Touch panel commands allow the programmer to modify the way the 1020 or 1021 reports to the host that a touch has been made.

Communications

The 1020 and 1021 have an RS-232-C/RS-422-A serial interface that supports full-duplex communication and allows connection to the host computer directly or through a modem. Baud rates are selectable in standard increments up to 19,200. The TCS uses ANSI standard display codes (ANSI x3.64-1979) and is powered from standard ac line voltage.

1020 Options

Amber Phosphor Display (1020-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 phosphor display is standard.

Tilt/Sivel Base (1020-31)

The Tilt/Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

1021 Options

Amber Phosphor Display (1021-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 phosphor display is standard.

Fan (1021-20)

An optional fan, including filter and filter cover, is available to increase the operating temperature range by 10°C.

1020

Enclosure (1021-30)

An attractive plastic enclosure is available for operating the Touch Control Screen on a desktop.

Tilt/Swivel Base (1021-31)

The Tilt/Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

Accessories

Alphanumeric Keyboard (Y1000)

The Alphanumeric Keyboard is provided for programming or data entry applications with the Touch Control Screen.

NEMA 12 Panel Mounting Kit (Y1070)

This kit provides the gasketing and mounting hardware necessary to give the Touch Control Screen a NEMA Type 12 rating (drip-proof, dust-tight) when panel mounted in a suitable enclosure.

19" Rack Mount Kit (Y1080)

The Y1080 is the front panel to use when mounting the Touch Control Screen into a 482.6 mm (19 in) wide instrumentation rack.

19" Rack Mount Kit with 18" Slides (Y1081)

The Y1081 is used for complete slide-mounting of the TCS with 18" slides.

19" Rack Mount Kit with 24" Slides (Y1082)

The Y1082 is identical to the Y1081 except that it provides 24" slides.

Keyboard Extender Cable (Y1085)

The Y1085 is used to extend the keyboard interface to the front panel of the Y1080, Y1081, and Y1082 rack mounting accessories.

Contrast Enhancement Overlay (Y1090)

The Y1090 is a gray overlay that enhances visual contrast between the display background and characters on the Touch Control Screen.

1030 Series

RS 232

1030

1030 Series

The 1030 Series Touch Control Screens are advanced operator interfaces. A great amount of functionality is built-in to these units to reduce host computer requirements and simplify programming. The 1030 Series has two models: the Model 1030 and 1031. The 1030 is a fully integrated TCS with bench-top enclosure, a complete manual set, and one Expansion Memory Module for Total Display Memory™ capability. Optional tilt-swivel base and amber display are available.

The Model 1031 is mountable in a panel or rack. Optional NEMA 12 panel mount kit for use in harsh environments is available, as well as 19" rack mount kits. A fan may also be added to the 1031 to extend the operating temperature range. Up to 3 Expansion Memory Modules can be ordered with the 1031 for Total Display Memory capability.

Total Display Memory

Total Display Memory is a unique capability that not only stores the visual characteristics of each application screen, but also all "Touchkey" programming and screen attributes. This screen storage capability preserves complete screen functionality and allows stored screens to be edited without disrupting the currently displayed screen. Because the 1030 Series employs an efficient data compression algorithm, less complex screens require proportionately less memory. Also, the transition from one stored screen to the next is virtually instantaneous.

Total Display Memory is added to the 1030 Series by inserting up to three Expansion Memory Modules. Two memory types are available: EEPROM and Non-Volatile RAM. Only one memory type can be used in any single TCS.

Software Integration

The 1030 Series provides a set of commands to easily create "Touchkeys," which are a group of touch cells configured to function as a single button. Touchkeys are also easily outlined on the display for a target, plus can be created to automatically provide visual/audible feedback to the operator when any one of their touch cells has been activated. Other commands create bar charts, set scrolling regions, and modify character attributes. The 1030 Series also has the ability for the programmer to create custom characters and download them into the TCS's system memory.

Communications

The 1030 Series and the host computer communicate via serial interface supporting full-duplex RS-232-C, RS-422-A, and RS-485. RS-232-C is used most in normal environments. In noisy environments, or for distances of up to 1200m (4000') RS-422-A is recommended. RS-485 is used in multidrop configurations supporting up to 32 TCSs on one host serial port.

1030 Options

Amber Phosphor Display (1030-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 is standard.

Tilt-Swivel Base (1030-31)

The Tilt-Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

1031 Options

Amber Phosphor Display (1031-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 is standard.

Fan (1031-20)

An optional fan, including filter and filter cover, is available to increase the operating temperature by 10°C.

Enclosure (1031-30)

An attractive plastic enclosure is available for operating the TCS on a pedestal or bench-top.

Tilt-Swivel Base (1031-31)

The Tilt-Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

Expansion Memory Module - Non-Volatile RAM (1031-40)

Expansion Memory Modules allow the 1031 to store all application screens, touchkey programming, and screen attributes. Up to three 1031-40s may be installed in a single 1031.

Expansion Memory Module EEPROM (1031-50)

Expansion Memory Modules allow the 1031 to store all application screens, touchkey programming, and screen attributes. Up to three 1031-50s may be installed in a single 1031.

Accessories

Alphanumeric Keyboard (Y1000)

The Alphanumeric Keyboard is provided for programming or data entry applications with the Touch Control Screen

NEMA 12 Panel Mounting Kit (Y1070)

This kit provides the gasketing and mounting hardware necessary to give the Touch Control Screen a NEMA 12 rating (drip-proof, dust-tight) when panel mounted in a suitable enclosure.

19" Rack Mount Kit (Y1080)

The Y1080 is the front panel to use when mounting the Touch Control Screen into a 482.6mm (19 in) wide instrumentation rack.

19" Rack Mount Kit with 18" Slides (Y1082)

The Y1081 is used for complete slide-mounting of the TCS with 18" slides.

19" Rack Mount Kit with 24" Slides (Y1082)

The Y1082 is identical to the Y1081 except that it provides 24" slides.

Keyboard Extender Cable (Y1085)

The Y1085 is used to extend the keyboard interface to the front panel of the Y1080, Y1081, and Y1082 rack mounting accessories.

Contrast Enhancement Overlay (Y1090)

The Y1090 is a gray overlay that enhances visual contrast between the display back-ground and characters on the Touch Control Screen

Specifications

1020 and 1030 Series

Temperature: 0°to50°C withoutplastic enclosure; 0°C to 60° without plastic enclosure, with optional fan; 0°C to 40°C with plastic enclosure; 0°C to 50°C with plastic encolsure,with optional fan

Voltage: 90V to 132V ac, 180V to 264V ac, 47 Hz to 440 Hz

Size: 335.3 mm W x 260.9 mm H x 330 mm D (13.2 in W x 10.3 in H x 13.0 in D), with enclosure; 318 mm D (12.5 in D) without enclosure

Weight: 8.44 kg (18.6 lb) without plastic enclosure

Touch Panel: 120 Touch Cells, 12 rows x 10 columns; with hardened scratch resistant surface

CRT: 305 mm (12.0 in) diagonal, Monochrome P31 Phosphor (green); PC194 Phosphor (amber), option

Ordering Information

1020 Series

January 1989 prices

1020 Touch Control Screen Package (includes 1021, enclosure, manual set)	$1820
1021 Touch Control Screen	1695

Options (1020)

1020-10 Amber Phosphor Display	35
1020-31* Tilt/Swivel Base	80

** Customer installable*

Options (1021)

1021-10 Amber Phosphor Display	35
1021-20* Fan with cover and filter	95
1021-30* Enclosure	80
1021-31* Tilt/Swivel Base (used on 1021-30)	80
1021-90 1020 Series Manual Set	55

** Customer installable*

1030 Series

1030 Touch Control Screen Pkg (includes 1031, enclosure, manual set, 1 Expansion Memory Module NVRAM)	2330
1031 Touch Control Screen	2095

Options (1030)

1030-10 Amber Phosphor Display	35
1030-31* Tilt/Swivel Base	80

** Customer installable*

Options (1031)

1031-10 Amber Phosphor Display	35
1031-20* Fan with cover and filter	95
1031-30* Enclosure	80
1031-31* Tilt/Swivel Base	80
1031-40** Expansion Memory Module NV RAM	90
1031-50** Expansion Memory Module EEPROM	300
1031-90 1030 Series Manual Set	75

** Customer installable*

*** Only one type of Expansion Memory can be ordered per 1031. Up to three (3) of the chosen option may be installed per 1031*

Accessories (1020 and 1030 Series)

Y1000 Alphanumeric Keyboard	225
Y1060*RS-485 Multidrop Adapter Cable	60
Y1062 TCS Null Modem Cable	125
Y1070 NEMA 12 Panel Mounting Kit	40
Y1080 19" Rack Mount Kit	70
Y1081 19" Rack Mount Kit w/18" Slides	200
Y1082 19" Rack Mount Kit w/24" Slides	210
Y1085 Keyboard Extender Cable	60
Y1090 Contrast Enhancement Overlay	25
Y1707 2m RS-232-C Cable	125
Y1708 10m RS-232-C Cable	150

** For 1030 Series only*

Service & Support

Warranty

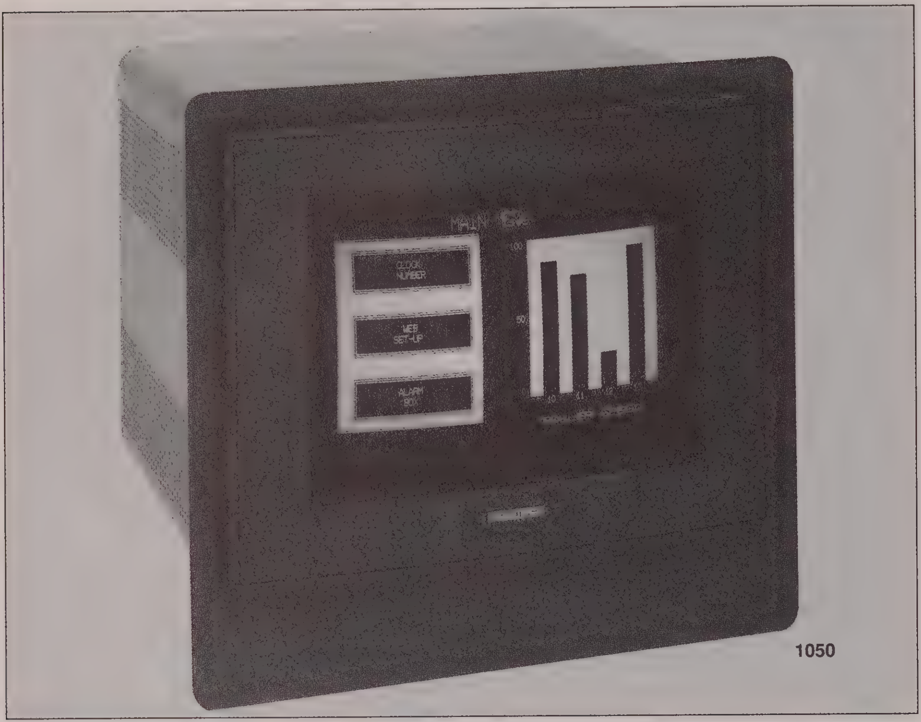
One-year product warranty. See page 470 for further information on warranty terms and conditions

Extended Warranty

SC1-1020 Repair	120
SC1-1021 Repair	120
SC1-1030 Repair	137
SC1-1031 Repair	137

1050 Series

RS-232



1050

1050 Series

The 1050 Series Color Touch Control Screen (CTCS) provides full color capability along with the same high level functionality of the 1030 Series. Up to 32 different colors can be displayed on any single 1050 screen. The 1050 Series has three models: the 1050 Color Touch Control Screen Package, the 1051 Color Touch Control Screen (panel mount), and the 1052 Color Touch Control Screen (rack mount).

The 1050 Series also has Total Display Memory™ capability, powerful firmware for ease of software integration, and multidrop capability of up to 32 CTCSs on a single host serial port. The 1050 Series meets NEMA 12 when panel mounted.

Specifications

1050 Series

Temperature: 0°C to 40°C without optional fan, 0°C to 50°C with optional fan

Voltage: 90V to 132V ac, 180V to 264V ac, 50/60 Hz

Touch Panel: 120 Touch Cells, 12 rows x 10 columns; with hardened scratch resistant surface

CRT: 305 mm (12 in) diagonal, 16 normal colors plus 16 highlight colors

Size: 1050/1051: 373.4 mm W x 345 mm H x 367.4 D. (14.7 in W x 13.6 in H x 14.5 in D). 1052: 482.6 mm W x 355.6 mm eight rack units H x 370.8 mm D (19.0 in W x 14.0 in eight rack units high x 14.6 in D)

Weight: 15.6 kg (34 lbs)

Ordering Information

Models

January 1989 prices

1050 Color Touch Control Screen Pkg (Includes 1051, manual set, 1 Expansion Memory Module NVRAM)	$3655
1051 Color Touch Control Screen (panel mount)	3500
1052 Color Touch Control Screen (rack mount)	3600

Refer to 1030 Series section for descriptions of Options and Accessories.

Options (1051)

1051-20 Fan (with filter)	95
1051-40* Expansion Memory Module (Non-Volatile RAM)	90
1051-50* Expansion Memory Module (EEPROM)	300
1051-60 Custom Connector Extender Cable (Factory Configured)	95
1051-90 1050 Series Manual Set	75

Options (1052)

1052-20 Fan (with filter)	95
1052-40* Expansion Memory Module (Non-Volatile RAM)	90
1052-50* Expansion Memory Module (EEPROM)	300
1052-60 Custom Connector Extender Cable (Factory Configured)	95
1052-81 18" Rack Slide Kit	140
1052-82 24" Rack Slide Kit	150
1052-90 1050 Series Manual Set	75

** Only one type of Expansion Memory option can be ordered per 1051 or 1052. Up to quantity three (3) of the chosen option may be installed per 1051 or 1052*

Accessories (1050 Series)

Y1000 Alphanumeric Keyboard	225
Y1060 RS-485 Multidrop Adapter Cable	60
Y1062 TCS Null Modem Cable	125
Y1085 Keyboard Extender Cable	60
Y1707 2m RS-232-C Cable	125
Y1708 10m RS-232-C Cable	150

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1050 Repair	150
SC1-1051 Repair	150
SC1-1052 Repair	150

1780A

RS-232

(NSN 7025-0-212-2063) **1780A**

1780A InfoTouch® Display

- Compact, rugged packaging
- Operates with any computer via RS-232-C
- 60 fingertip-sized touch sensitive areas
- Crisp, alphanumeric and character graphic display

The 1780A provides a simple yet sophisticated means of interfacing an operator to a complex control process.

Whether the operator is highly skilled in a particular manufacturing or test process, or is a first-time or occasional user of an on-line information system, the 1780A is the ideal link between the user and the computer at the heart of your system. The 1780A's display screen is used to present choices to the operator, and the transparent, touch-sensitive switch matrix over-laying the display receives the operator's response to those choices. Complicated processes can be performed in a series of steps, each involving a small number of choices.

The InfoTouch Display eliminates the complexity of remembering and correctly entering system commands at a conventional keyboard. And since the operator can only act upon the choices presented to him on the display, the possibilities of error are greatly reduced. Information can be presented to the operator in numbers, letters, graphic messages, or custom symbols or alphabets. The touch-sensitive overlay covers most of the screen, and provides 60 fingertip sized touch areas.

Customizing the InfoTouch Display panel is a simple programming task of writing and storing sequences of ASCII characters and display control codes. Since the ASCII sequences are not dependent upon software language, the InfoTouch Display can be used with virtually any host computer. And since the displays are stored in your computer's software or firmware, changes can be easily made as you update the capabilities of your system.

The standard InfoTouch Display allows display of the full ASCII character set plus eleven standard graphics characters for creating simple line drawings or outlining touch-sense areas. Expanded graphics capabilities are optionally available via the 1780A-201 Expanded Graphics Character Set. This option provides 128 more graphics characters to let you generate complex process diagrams or other graphic displays.Or, if you like, you can customize the character sets for your particular system needs.

Optional Keyboard Interface

The Keyboard Interface Option (-001) gives the 1780A another input and output mode in addition to the touch sensitive screen. It may be used with a customized keypad, test fixture, or with the Y1720 Programmer Keyboard for operation as a standard terminal. There are also five TTL output lines on the interface which can be controlled through remote commands from the host.

Accessory Descriptions

Y1791 is a rack mount adapter with a blank filler panel. It allows the 1780A to be mounted to either the right or left side of standard 19-inch rack enclosures. Rack slides or a rack shelf are required for complete mounting of the 1780A in a rack.

Y1792 is a rack mount adapter with a keyboard extension cable. It is similar to Y1791 but includes an extension cable mounted to the filler panel which will extend the function of the 1780A-001 Keyboard Interface to the front panel. Rack slides or a rack shelf are required for complete mounting of the 1780A in a rack.

Y1793 is a carry handle that can be easily installed in place of the trim on either side of the 1780A.

Y1720 Full ASCII keyboard.

Specifications

Signal Emissions: Meets FCC Part 15, Subpart J, Class A
Temperature: 0°C to 50°C, operating; -40°C to +65°C, non-operating
Relative Humidity: To 95% from 0°C to 25°C, 75% to 40°C, and 45% to 50°C, non-condensing
Power: 90V to 132V ac, or 198V to 264V ac, 47 to 63 Hz, 55W maximum
Safety: Protection Class II per IEC 348
Size: 13.3 cm H x 28.8 cm W x 34.4 cm D (5.23 in x 11.35 in x 13.55 in). Standard 5-1/4-inch rack height
Weight: 9.7 kg (22 lb)

Ordering Information

Models

	January 1989 prices
1780A InfoTouch® Display	$2150

Options

-001* Keyboard Interface	155
-002* Keyboard Interface w/Y1720 Keyboard	415
1780A-201 Expanded Graphics Character Set	260

**Customer installable*

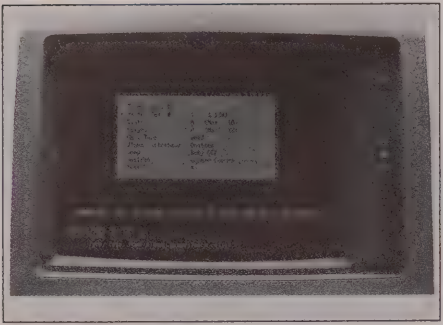
Accessories (Also see page 485)

Y1062 TCS Null Modem Cable	125
Y1707 2m RS-232-C Cable	125
Y1708 10m RS-232-C Cable	150
Y1720 Keyboard	350
Y1791* Rack Adapter	95
Y1792* Rack Adapter and Keyboard Cable	195
Y1793 Carry Handle	40
M00-260-610 18" Rack Slide Kit	130
M00-270-610 20" Rack Slide Kit	130
M00-280-610 24" Rack Slide Kit	130

**Separately order rack slides M00-260-610,M00-270-610, or M00-280-610*

Software Development Tools

NEW



Software Development Tools

Fast software integration is accomplished by three application development tools. All three run on the IBM family of Personal Computers (PCs) and compatibles.

- ScreenBuilder™
- IconBuilder™
- TCS Toolbox™

ScreenBuilder

ScreenBuilder is a development tool that allows the user to completely develop 1030 or 1050 stored screens simply by "filling in the blanks" on the PC. ScreenBuilder can be used as an "off-line" tool apart from the target system of the TCS application. In fact much of the screen development may be done without a TCS by viewing a representation of the screen on the PC monitor.

ScreenBuilder stores screens on a PC disk or in the TCS's optional memory.

ScreenBuilder features:

- Full support for all elements of stored screens. No additional programming is required to complete stored screens.
- Moving and editing of touchkeys, regions, and text.
- Complete control over characters attributes and colors* of touchkeys, regions, and text in any combination.
- Double-size, double-width, and normal size text.
- Hardcopy documentation for reference during host software development.

** Color is only available on the 1050 Series of Touch Control Screens.*

IconBuilder

IconBuilder allows the user to create character fonts and icons for custom displays on the 1030 and 1050 Series TCSs. Much like ScreenBuilder, IconBuilder gives the designer the flexibility of creating and downloading apart from the target system. In use, TCS characters are enlarged on the PC screen so that each pixel can be edited. Once developed, these custom fonts and icons are stored on the PC disk or downloaded to the Touch Control Screen.

IconBuilder features:

- Juxtaposed character editing for creating icons.
- Character block moves for rearranging characters within a font.
- Easy character copying and replicating.
- Actual-size and enlarged character viewing on the PC monitor.
- Storage of all or part of the character font in the TCS or in "download files."
- Hardcopy documentation.

TCS Toolbox

The TCS Toolbox provides twelve unique functions that facilitate the development of a 1020 Series application program. Each individual function is called from QuickBASIC in a single program statement. Among the various routines are ones to place touchkeys, center and format text, automate numeric and alphanumeric data entry, and several to simplify touch report decoding. For fast debugging, complete error checking and reporting are performed. For customization, all source code is included.

The TCS Toolbox is best suited for 1020 Series Touch Control Screens. It uses only the low level functions supported by the 1020 Series, and works without screen memory.

Compatibility and Features

	TCS Toolbox	Icon Builder	Screen Builder
For Use w/1020	X	•	•
For Use w/1030	•	X	X
For Use w/1050	•	X	X
Creates Stored Screens	•	•	X
Creates Custom Fonts	•	X	•
Decodes Touch Reports	X	•	•

System Requirements

ScreenBuilder and IconBuilder:

- Fluke 1030 or 1050 Series TCS.
- IBM PC, PC/XT, PC/AT or equivalent.
  - 512K of memory (or more).
  - 5-1/4 inch floppy disk drive.
  - Serial port (optional but recommended).
  - Parallel printer port (optional).
  - Printer (optional).
- PC-DOS or equivalent, version 2.12 or later.
- Fluke Y1062 TCS Null Modem Cable or equivalent (a wiring diagram is included in the ScreenBuilder manual).
- VGA, EGA, CGA, MDA, Hercules or equivalent graphics card.

TCS Toolbox:

Same as ScreenBuilder/IconBuilder except for:

- Fluke 1020 Series TCS.
- 320K of memory (or more) in the PC.
- Microsoft QuickBASIC version 2.0 or later.

Ordering Information

Models

	January 1989 prices
S1005 ScreenBuilder	$95
S1008 IconBuilder	95
102X-902 TCS Toolbox	95

Digital Thermometers

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Fluke specializes in two basic kinds of digital thermometers: those that measure temperature using thermocouples and those that measure temperature using resistance temperature devices (RTDs). Fluke RTD thermometers are used when the greatest accuracy is required.

Fluke thermocouple thermometers range in style and purpose from handheld battery operated models (50 Series) used frequently by service technicians, to the more precise and versatile 2190A. The 2190A can be used with a printer and automatic scanner to record the temperature from many sensing points.

NOTE: Fluke data loggers should not be overlooked as temperature measurement instruments. They measure temperature using either thermocouples or RTDs from multiple points. Also, Fluke makes accessories for digital multimeters which allow temperature measurements.

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Handheld Thermometers 437
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Portable & Rackmountable
Thermometers 439

Selection Guide

	Panel Mount		Portable or Rackmountable									
Features	**2160A**	**2170A**	**2165A**	**2166A**	**2168A**	**2175A**	**2176A**	**2190A**	**2180A**	**2189A**	**51**	**52**
Page	**439**	**439**	**439**	**439**	**439**	**440**	**440**	**444**	**444**	**444**	**437**	**437**
Pt, Ni, Cu Type RTDs	—	—	—	—	—	—	—	—	All	Pt	—	—
NBS Type B, E, J, K, R, S, T, C T/Cs *	All	E,J,K,T	All	All	All	E,J,K,T	E,J,K,T	All	—	—	J,K	J,K
DIN Type J, T, T/Cs	No	No	No	No	No	No	No	Both	—	—	—	—
Measurement Resolution C	1°	0.1°	1°	1°	1°	0.1°	0.1°	0.1°	0.01°	0.01°	0.1°	0.1°
Number of Digits	4	4	4	4	4	4	4	5	5	5	5	5
Single Alarm Limits	—	—	—	—	—	—	—	-006	-006	-006	—	—
Selectable Input Points	1	1	1	10	1	1	10	1	1	1	1	2
Multipoint Selector, Manual	2161A	2161A	**	—	**	**	**	Y2001	Y2000	Y2000	—	—
Points Per Selector	10	10	**	—	**	**	**	10	10	10	—	—
Maximum Points	30	30	**	—	**	**	**	100	100	100	1	2
Batteries	—	—	-01	Y2004	Y2004	-01	Y2004	Y2009	Y2009	Y2009	Inc	Inc
External 12V DC Operation	—	—	—	Yes	Yes	—	Yes	Yes	Yes	Yes	—	—
Analog Output Option	-04	-04	-04	-04	-04	-04	-04	-002	-002	-002	—	—
Digital Output Option	-02	-02	-02	-02	-02	-02	-02	-002	-002	-002	—	—

**Type "C" is not an ANSI/ISA approved designation. It is used to designate Tungsten-5% Rhenium vs. Tungsten-26% Rhenium.*
***Works with 2161A Multipoint Selector except case style is different.*
[1] *Also see 8520A/PRT Precision Thermometry Systems*

Thermometry Product Summary

2160 and 2170 Series: Low-cost, high-accuracy digital thermocouple thermometers in either bench/portable or panel mount styles for applications requiring 1°or 0.1°resolution.

8520A/PRT: Best accuracy from -200 degrees C to +350 degrees C. A Rosemount Special 162N Platinum Resistance Thermometer Probe (PRT) and a Fluke 8520A 5 1/2-Digit Precision Multimeter having a built-in, customized linearization curve to match the specific PRT.

2180A, 2189A, and 2190A: Fluke's most accurate and versatile general purpose digital thermometers for RTDs or thermocouples. You may stack and latch each thermometer to a wide range of accessories, including manual multipoints, a battery pack, and a thermocouple calibrator.

50 Series: The 50 Series combine Fluke's technical expertise in low-cost handheld test instruments and laboratory-grade benchtop temperature instruments to create one of the most advanced, yet affordable, handheld thermometer lines in the industry.

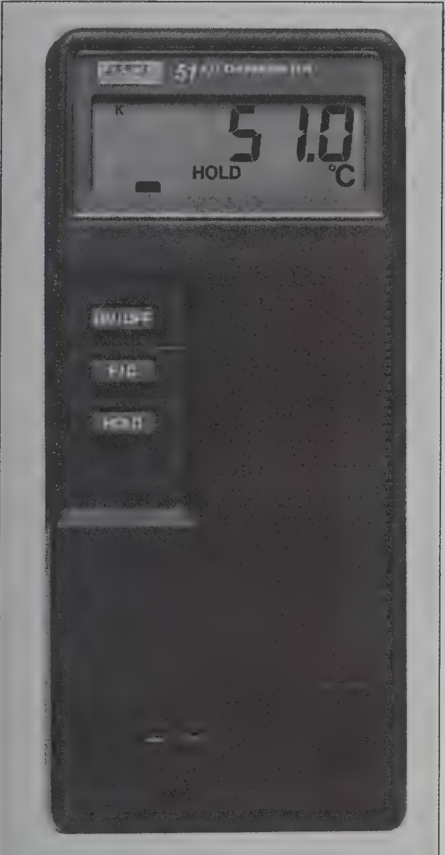
2300A Scanner: Designed to be used with a 2180A or 2190A Digital Thermometer. The 2300A will automatically scan up to 100 points of temperature, using either a 2180A and RTDs or a 2190A and thermocouples. The unit can also run under computer control.

Temperature Logging Systems: Choose from two models—one for RTDs and one for thermocouples. These factory-tested systems include a thermometer, scanner, and printer for precision temperature logging that is also portable.

2020A and 2030A Printers: Allow you to log data from a thermometer or a scanner and thermometer. The 2030A permits mX+b math scaling and trend plotting.

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Fluke 51 & 52



51

52

Fluke 50 Series Thermometer

- Self-test
- J or K-type thermocouples
- °C or °F display
- Reading hold function
- Single thermocouple input
- 1°C or 0.1°C (1°F or 0.2°F) resolution

Additional for the Fluke 52

- Dual thermocouple input
- Differential temperature (T_1-T_2)
- Scan function (T_1, T_2, T_1-T_2,...)
- Min/Max record
- User-selectable resolution
- 1°C or 0.1°C (1°F or 0.2°F)

The Fluke 51 & 52 Digital Thermometers are designed for high accuracy and resolution with excellent repeatability. Their price/performance ratio is unmatched in the industry. Reliability, a three-year warranty, and 1200-hour battery life combine to give users the lowest possible cost of ownership.

The Fluke 51 is a high quality, high performance Digital Thermocouple Thermometer. The most demanding users will get everything they expect and more from this rugged, single-input unit.

The Fluke 52 has several additional measurement functions and high-performance features. Dual inputs (T_1 and T_2) allow two individual points to be monitored, and provide information for the differential mode (T_1 minus T_2). A MIN/MAX register is available for any input (T_1,T_2 or T_1-T_2). At power-up the user can select a "scan" mode, which scrolls through the three modes in a T_1,T_2,T_1-T_2 continuous sequence. Also selectable at power-up is the choice of high resolution (0.1 degrees C or 0.2 degrees F) or low resolution (1°C or 1°F) readouts.

Specifications

Technical Specifications

Temperature Scale: Celsius or Fahrenheit user-selectable

Resolution: 1°C or 1°F (or 0.1°C or 0.2°F) user selectable

Thermocouple Types: K-type or J-type that conform to NBS and IEC 584 tables, user-selectable

Measurement Range: K-type range is -200°C to 1370°C (-328°F to 2498°F). J-type range is -200°C to 760°C (-328°F to 1400°F). Also check the rated range of the thermocouple to be used. For Fluke K-type probes see page 134

Meter Operating Range: For use in 0°C to 50°C environment (32°F to 122°F)

Meter Accuracy: Specified for a period of one year when meter is operated in an environment of 18°C to 28°C (64°F to 82°F). Thermocouple errors should be added to meter errors to determine measurement accuracy. See thermocouple manufacturer's data.or, for Fluke K-type probes, see page 134

Model	Accuracy ±(%of Rdg + °C)		Accuracy ±(%of Rdg + °F)	
	Type K	Type J	Type K	Type J
51 or 52	0.1% + 0.7°C	0.1% + 0.8°C	0.1% + 1.3°F	0.1% + 1.4°F
52* T_1-T_2	0.1% + 1.0°C	0.1% + 1.2°C	0.1% + 1.8°F	0.1% + 2.2°F

**Typical accuracy only for T_1 minus T_2 temperature*

Temperature Coefficient: Within the meter operating range, add to the meter accuracy specification 0.01% of reading +0.03°for each°below 18°C (64°F) or above 28°C (82°F)

Error Offset: Errors contributed by one particular thermocouple may be pratically eliminated, over a limited measurement range, using a recessed front panel OFFSET adjustment on the meter and an accurate temperature standard when making the adjustment. Although making that adjustment may increase measurement errors made using other thermocouples, the two-input Model 52 offers a means of adjusting one input and dedicating it to making particularly accurate measurements while using the other input for all other thermocouples

Input Connectors: For Standard miniature K-type or J-type polarized thermocouple plugs with flat, in-line blades spaced 7.9 mm (0.312 in) center to center

Maximum Input: 60V dc or 24V rms ac between the input pins or any input and ground. Maximum of 1V between inputs T1 and T2 on the Model 52

Reading Rate: 1 second per reading for one probe, 1.7 seconds per reading in the scan mode with the Model 52

Storage Temperature: -40°C to 60°C (-40°F to 140°F)

Relative Humidity: To 90% up to 35°C (95°F); to 70% up to 50°C (122°F)

Fluke 51 & 52

General Specifications

Battery: Standard 9V battery (NEDA 1604, 6F22, or 006P)
Battery Life: 1200 hours. Low battery indicator appears when less than 50 hours of battery life remain
Safety: Protection Class III as defined in IEC 348, Safety Requirements for Electronic Apparatus.
Size: 2.84 cm x 7.49 cm x 16.64 cm (1.12 in x 2.95 in x 6.55 in)
Weight: 280 gm (10 oz.)
Included: Battery, 80PK-1 probe for general purpose measurements (two with the 52), and operator's manual

Ordering Information

Models

January 1989 prices

51 Digital Thermometer	$129
52 Digital Thermometer	169

Accessories (Also see page 485)

80PK-1 Bead Air Probe, -40°C to 260°C	12
80PK-2A Inconel Sheath Immersion Probe, -196°C to 927°C	36
80PK-3 Surface Probe, -28°C to 260°C	69
80PK-4A Air Probe, -196°C to 816°C	49
80PK-5 Stainless Steel Piercing Probe, -196°C to 816°C	36
80PK-6A Exposed Probe, -196°C to 816°C	43
80CJ-M Male Type J Mini Connector (pkg. of 2)	7
80CK-M Male Type K Mini Connector (pkg. of 2)	7
C25 Compact Soft Case for 50 Series w/ C70 holster	20
C50 Compact Soft Case	15
C70 Protective Holster	14
C100 Universal Hard Carrying Case	30

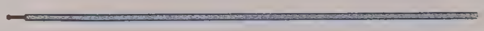
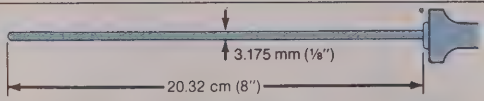
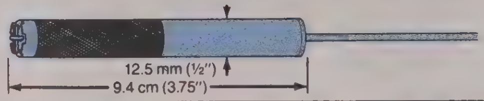
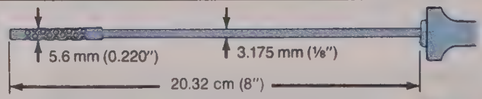
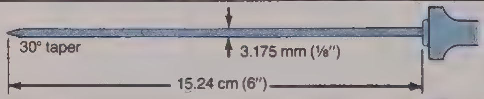
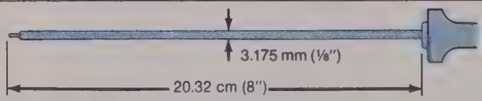
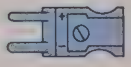
Service & Support

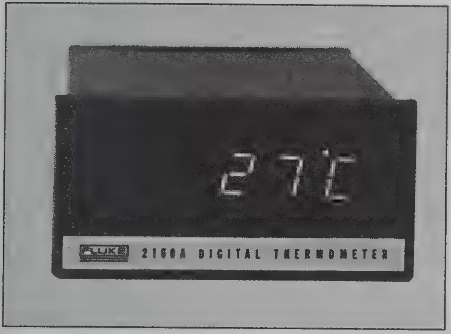
Warranty

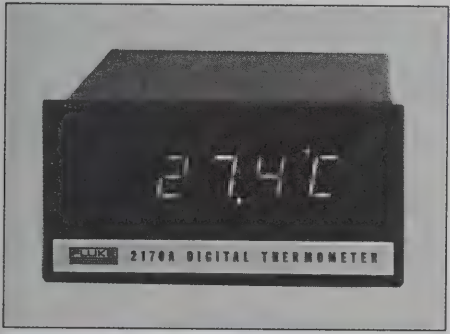
Two-year product warranty. See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)

K-Type, Thermocouples,
(See page 134 for specifications)

Model	Range	Style
80PK-1 Bead Air Probe	-40°C to 260°C (-40° F to 500°F)	
80PK-2A Inconel Sheath Immersion	-196° C to 927°C (-320°F to 1700°F)	
80PK-3 Surface Probe	-28°C to 260°C (-18.4°F to 500°F)	
80PK-4A Air Probe	-196°C to 816°C (-320°F to 1500°F)	
80PK-5 Stainless Steel Piercing Probe	-196°C to 927°C (-196°F to 1700°F)	
80PK-6A Exposed Probe	-196°C to 927°C (-320°F to 1500°F)	
80CK-M Male Type K Mini Connector (pkg. of 2) (20 AWG Max)	N/A	
80CJ-M Male Type J Mini Connector (pkg. of 2) (20 AWG Max)	N/A	

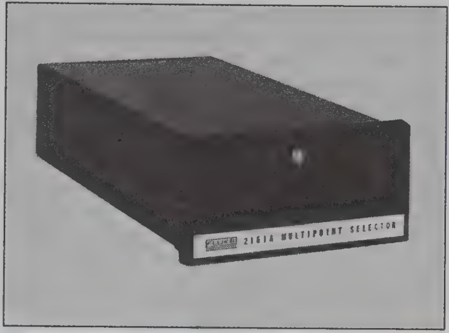




2160A & 2170A Thermometer

The 2160A and 2170A Thermometers are designed to be mounted in a panel. The panel opening required is a rectangle that is only 4.5 cm high by 9.2 cm wide, conforming to DIN Standard 43700. Both thermometers will indicate temperature in°Celsius or degrees Fahrenheit and an internal jumper is used to switch from one scale to the other.

The 2160A has a 1°C or 1°F resolution and uses any one of eight thermocouple types (J,K,T,E,R,S,B,or C). The 2170A has a 0.1°C or 0.1°F resolution and uses any one of four thermocouple types (J,K,T,or E). Both the 2160A and 2170 A are physically and electrically compatible with the 2161A Multipoint Selector.

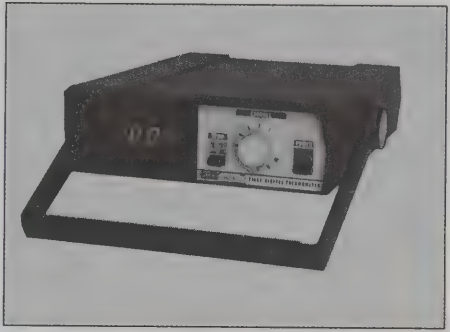


2161A Multipoint Selector

The Model 2161A Multipoint Selector is a panel-mounting, manually switched selector that allows 1 to 10 thermocouple probe of the same type to function as the input of the 2160A, or 2170A or other thermocouple thermometers. Two or more 2161As can be connected in series for monitoring more than ten inputs.

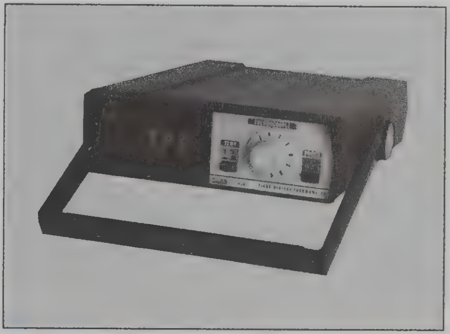
2165A Digital Thermometer

A single-point instrument in a rugged, portable case with specifications identical to the 2160A. It can be equipped with internal rechargeable batteries. Pushbutton controls include power (ON-OFF), temperature scale selection (°F/ °C), and battery charge (ON-OFF). Resolution is 1°F or 1°C.



2166A Multipoint Thermometer

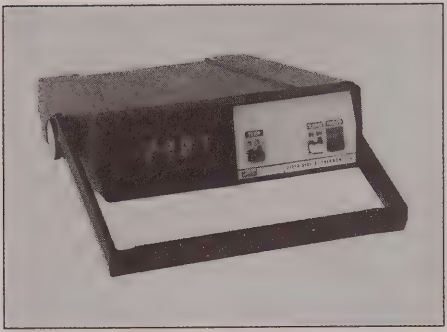
The 2166A is the same basic bench-type instrument as the 2165A but with the capability for monitoring up to 10 thermocouples of the same type. Thermocouple channel selection is by a 10-position front panel rotary switch. Power is either line voltage or external 12V dc (Y2004 Battery Pack has rechargeable batteries). Resolution is 1°F or 1°C.



2168A Multitype Thermometer

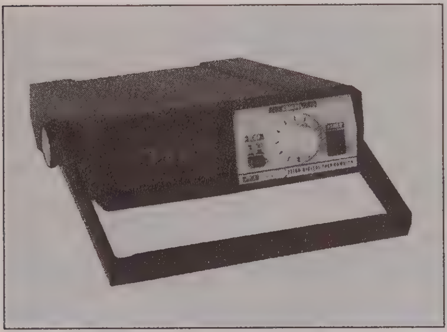
The 2168A is a portable, single-point instrument capable of accepting the output from any one of eight thermocouple types. Performance specifications are identical to the 2160A for each thermocouple type. Front panel controls include pushbutton power switch (ON-OFF) and temperature scale selection (°F or °C), plus an eight-position rotary switch for selecting thermocouple type. Power is either line voltage or external 12V dc (with Y2004 Carrying Case). Resolution is 1°F or 1°C.

2160A & 2170A Series



2175A Digital Thermometer

The 2175A is a single-point instrument in a rugged portable bench-mount case with the same specifications as the 2170A. It can be equipped with internal rechargeable batteries. Pushbutton controls include a power switch (ON-OFF), temperature scale selection (°F/°C), and battery charge. Resolution is 0.1°F or 0.1°C.



2176A Digital Thermometer

The 2176A is the same basic bench-type instrument as the 2175A but with the additional capability of monitoring up to 10 thermocouples (of the same type). Thermocouple channel selection is by means of a 10-position front panel rotary switch. Power is either line voltage or external 12V dc (with Y2004 Battery Pack). Resolution is 0.1°F or 0.1°C.

Specifications

Technical Specifications

Compatible Thermocouple Types:
2160A Series: J,K,T, E, R, S, B, C
2170A Series: J,K,T,E
Measurement Method: Dual-slope integration over a 100 ms period
Drift: None, automatic zero correction
Reading Rate: 2.5 readings per second
Conversion °C to °F: Jumper-selectable in panel-mount models, Switch-selectable on portable models.
Input Connections: Screw terminals on isothermal connector
Input Circuit: Two-wire, isolated
Input Impedance: 100 MΩ
Input Current: 500A
Source Impedance: 5 kΩ (5 kΩ causes <0.2°C error with K thermocouple)
Maximum Input Voltage: 400V dc or peak ac continuously, between inputs or either input and ground
Maximum Common Mode Voltage: 400V dc or peak AC
Common Mode Rejection: ≥120 dB at 50, 60, 400 Hz ±0.1% with 1 kΩ source impedance unbalance
Normal Mode Rejection: ≥60 dB at 50,60,400 Hz ± 0.1%
Overload: Display flashes when input voltage exceeds full-scale temperature range
Open Input: Display flashes to indicate open at input terminals
Response time: ≤2.0 second to rated accuracy

2160A Series Accuracy Specification

Thermocouple Type	Applicable Temperature Range °C	Maximum Error** (±°C)			Applicable Temperature Range °C	Maximum Error** (±°F)		
		Calibration Accuracy	90 Days 68 to 86°F	1 Year 59 to 95°F		Calibration Accuracy	90 Days 20 to 30°C	1 Year 15 to 35°C
J	-189 to 0	1	1.5	1.5	-328 to 32	1.5	2	2.5
	0 to 778	1	1	1.5	32 to 1432	1	1.5	2
K	-189 to 0	1	1.5	2	-328 to 32	2	2.5	3
	0 to 1356	1	1.5	2	32 to 2472	1.5	2.5	3
T	-189 to 0	1	1.5	2	-328 to 32	1.5	2	3.5
	0 to 400	1	1	1	32 to 752	1	1.5	2
E	-189 to 0	1	1.5	2	-328 to 32	1.5	2	3.5
	0 to 1000	1	1	1.5	32 to 1832	1	2	2.5
R	0 to 1756	1.5	2.5	3	32 to 3232	2	4	5
S	0 to 1733	1.5	2	3	32 to 3232	2	3.5	4.5
B	533 to 1800	1.5	2	2.5	992 to 3352	2	3.5	4.5
C*	0 to 2284	2	3	3	32 to 3999	3	5	5.5

**C designates Tungsten-5% Rhenium vs. Tungsten-26% Rhenium*

***Max. error includes NBS conformity, calibration, span, zero, reference junction, noise and stability, but not thermocouple errors. Add 0.1° C or 0.2° F for Model 2166A.*

2170A Series Accuracy Specification

Thermocouple Type	Applicable Temperature Range °C	Maximum Error ** (±°C)			Applicable Temperature Range °C	Maximum Error** (±°F)		
		Calibration Accuracy	90 Days 20 to 30°C	1 Year 15 to 35°C		Calibration Accuracy	90 Days 68 to 86°C	1 Year 59 to 95°C
J	-99.9 to 0	0.5	1	1.2	-99.9 to 32	0.9	1.6	2.1
	0 to 777.9	0.4	0.7	1.1	32 to 999.9	0.7	1.2	1.6
K	-99.9 to 0	0.7	1.2	1.5	-99.9 to 32	1.1	2.0	2.6
	0 to 999.9	0.5	1.1	1.4	32 to 999.9	1	1.4	1.8
T	-99.9 to 0	0.6	1	1.6	-99.9 to 32	0.9	1.7	2.9
	0 to 400	0.4	0.6	0.9	32 to 752	0.6	1	1.5
E	-99.9 to 0	0.6	1	1.7	-99.9 to 32	0.9	1.7	3.0
	0 to 999.9	0.5	1	1.4	32 to 999.9	0.8	1.3	1.8

**Max. error includes NBS conformity, calibration, span, zero, reference junction, noise and stability, but not thermocouple errors. Add 0.1°C and 0.2° F for Model 2176A.*

Option Specifications

Rechargeable Batteries (-01)

Used in Models 2165A and 2175A for portable-operations, and provides a continuous operating time of 8 hours. The internal batteries are rechargeable from line power in either trickle or full charge mode. They are field-installable at a later date.

Digital Output Unit (-02)

A field-installable option that provides a parallel BCD digital output equivalent to the displayed measurement date. Output data is solicited by and External Trigger and valid data is insured by Busy and Not Busy outputs. Output is fully buffered TTL/DTL compatible, isolated to 300V. A 6-foot ribbon cable and connector are included. Operates only when powered by AC line.

Analog Output Unit (-04)

A field-installable assembly which provides an output voltage of 1 mV per degree (Celsius or Fahrenheit) up to 4,000V (4000 degrees). Automatic polarity sensing is provided so that the polarity of the output voltage agrees with the displayed temperature. The output voltage is isolated from the input and referenced to the low terminal of the external voltmeter, stripchart recorder, etc. A 6-foot pair of wires and connector are included. Accuracy is ± 0.5% of reading ±1 mV. Operates only when powered by AC line.

Digital Thermometers

2160A & 2170A Series

General Specifications

Type of Display: LED

Shock and Vibration: Meets requirements of MIL-Std-810

Ambient Temperature: 0°C to 50°C, operating; -40°C to 60°C with batteries, -40°C to 75°C without batteries, non-operating

Relative Humidity: ≤90% from 0°C to 35°C, ≤80% to 50j°C, non-condensing

Line Operation: 115V ac ± 10%, 50 to 440 Hz, 8W (Bench), 4W (panel). 100V ac and 230V ac versions are also available

Battery Operation: Option -01 for the 2165A and 2175A operates eight hours on a full charge. Y2004 Battery Pack for 2166A, 2168A, and 2176A operates six hours on a full charge, typically

External DC Source: (2166A, 2168A, and 2176A)11 to 15V dc at 400 mA. Y2004 recommended

Size: (2165A, 2166A, 2168A, 2175A and 2176A) 6.4 cm H x 21.7 cm W x 25.2 cm D (2.52 in H x 8.55 in W x 9.9 in D)

Size: (2160A and 2170A) conforms to DIN standard 43700. 4.8 cm H x 9.6 cm W x 20.5 cm D(1.88 in H x 3.78 in W x 8.05 in D). Panel cutout is 9.2 cm x 4.5 cm (3.62 in x 1.77 in)

Weight

2165 and 2175A: 1.19 kg (2.63 lb) without batteries, 1.79 kg (3.95 lb) with batteries

2166A, 2168A, 2176A: 1.35 kg (3 lb)

2160A, 2170A: 0.74 kg (1.63 lb)

Warranty Period: One year

Included: Instruction manual, power cord. Thermocouple or thermocouple probe not included.

Ordering Information

Models

January 1989 prices

2160A Thermometer (panel-mount)	$440
2161A Multipoint Selector (panel-mount)	210
2165A Thermometer	575
2166A Thermometer (10 points)	680
2168A Thermometer (8 types)	810
2170A Thermometer (panel mount)	480
2175A Thermometer	675
2176A Thermometer (10 points)	800

**Thermocouples or probes not included. Specify thermocouple type to be used.*

Options (for 2165A or 2175A only)

-01* Rechargeable Batteries	95

Options (for all above Models)

-02** Digital Output (w/ cable)	180
-04** Analog Output (w/ cable)	235

** For 2165A and 2175A only*

*** Mutually exclusive in one instrument*

Accessories (Also see page 485)

See next page for Digital Thermometers Accessories

Service & Support

Warranty

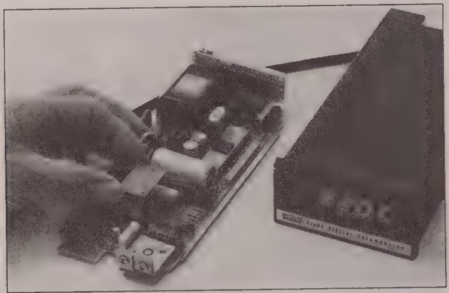
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty*

SC1-2160A Repair (w/ calibration)	$41
SC1-2160A Repair (cal w/in or out data)	76
SC1-2160A Repair (cal w/in and out data)	111
SC2-2160A Cal (1/yr recommended)	31
SC2-2160A Cal (1/yr w/in or out data)	66
SC2-2160A Cal (1/yr w/in and out data)	101
SC1-2161A Repair (w/ calibration)	31
SC1-2161A Performance Test only (1/yr)	31
SC1-2165A Repair (w/ calibration)	43
SC1-2165A Repair (cal w/in or out data)	78
SC1-2165A Repair (cal w/in and out data	113
SC2-2165A Cal (1/yr recommended)	31
SC2-2165A Cal (1/yr w/ in or out data)	66
SC2-2165A Cal (1/yr w/in and out data)	101
SC1-2166A Repair (w/ calibration)	52
SC1-2166A Repair (cal w/in or out data)	87
SC1-2166A Repair (cal w/in and out data)	122
SC2-2166A Cal (1/yr recommended)	31
SC2-2166A Cal (1/yr w/ in or out data)	66
SC2-2166A Cal (1/yr w/in and out data)	101
SC1-2168A Repair (w/ calibration)	82
SC1-2168A Repair (cal w/in or out data)	117
SC1-2168A Repair (cal w/in and out data)	152
SC2-2168A Cal (1/yr recommended)	31
SC2-2168A Cal (1/yr w/in or out data)	66
SC2-2168A Cal (1/yr w/in and out data)	101

**Extended Warranty available on other models also.*

Available through Distributors (See page 500)

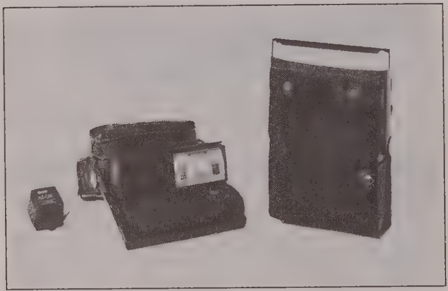


Thermocouple Type Conversion Kits

Your 2160-or 2170-Series Digital Thermometer may be equipped to work with only one type of thermocouple at a time. But it is very simple to convert it to be used with a different type thermocouple with an inexpensive conversion kit. Section II of your instruction manual tells how.

A conversion kit for a J, K, T, or E type thermocouple may be installed in any 2160 or 2170 Series Thermometer. In addition, a kit for a type R,S,B, or C may be installed in 2160 Series (but not the 2170 Series)

NBS Type	Conversion Kit No.	NBS Type	Conversion Kit No.
J	2160A-7016 $35	R	2160A-7012 $35
K	2160A-7017 35	S	2160A-7013 35
T	2160A-7018 35	B	2160A-7014 35
E	2160A-7019 35	C	2160A-7015 35



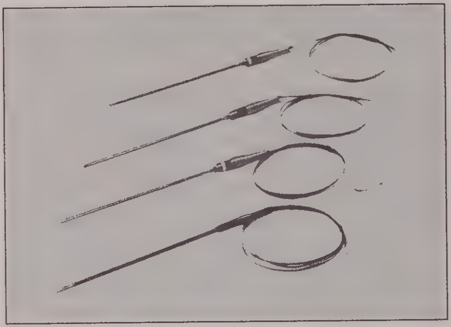
Y2004 Case and Battery Pack

The Y2004 consists of a case, 12-volt battery pack, and charger for use with the 2166A, 2168A, and 2176A. The Y8205 is a case only for any bench model 2160 or 2170 Series Thermometer. The Y2004 is especially recommended for the 2166A, 2168A, and 2176A Digital Thermometers because those models are not available with a self-contained rechargeable battery pack but have external 12-volt power connectors.

Typical operating time with batteries having a full charge is six hours. Recharge time at 25°C is approximately 15 hours.

Y2004 Carrying Case/Battery Pack & Charger	$205
Y8205 Carrying Case	35

P20 Series Thermocouple Probes

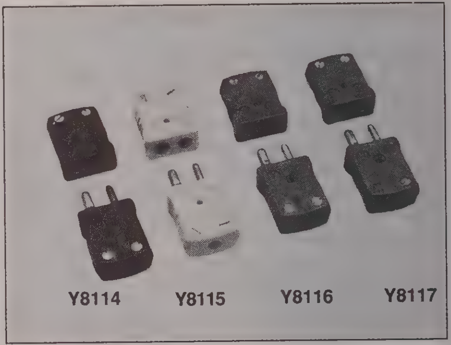


These probes are ANSI Standard accuracy general prupose immersion type probes. They have sheaths 6-inches long by 1/8-inch diameter made of INCONEL.

The thermocouple lead wire is three feet long and its insulation will withstand temperatures up to 480°C continually. Inside the sheath, the wires are insulated with magnesium oxide but are grounded to the sheath at the junction. They are particularly intended for use with Fluke 2190A Digital Thermometers and the 2160-Series, 2170 Series Digital Thermometers.

The 80PK, Type K Series Probes shown on page 134 can also be used with the 2160 Series, 2170 Series, and 2190A Digital Thermometers by simply cutting off the attached thermocouple plug and attaching the bare end of the wires to the thermometer inputs.

Type	Useful Range
P20J $63	-150° to 875°C
P20K 63	-150° to 1260°C
P20T 63	-150° to 400°C
P20E 63	-270° to 1000°C

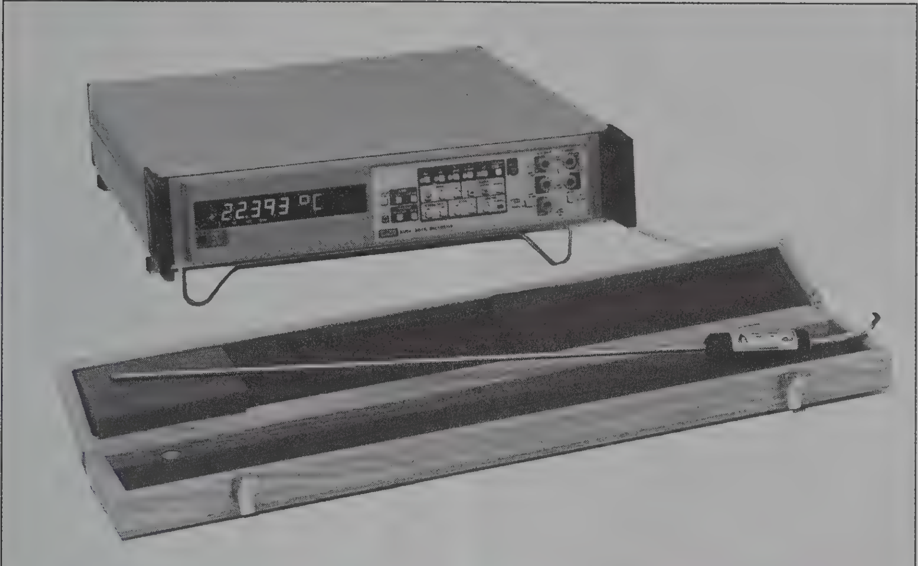


Thermocouple Probe Extender Connectors

Matching thermocouple connectors should be used to extend length of leads when using thermocouple probes. Connectors and 100-foot lengths of #20 AWG thermocouple wire are available. Connectors are made of thermocouple material and should match the type of thermocouple wire.

NBS Type	Probe Type	Mating Connectors	Thermocouple Wire (100 ft.)
J	P20J	Y8114 $16	Y8110 $68
K	P20K	Y8115 16	Y8111 115
T	P20T	Y8116 16	Y8112 115
E	P20E	Y8117 16	Y8113 115

8520A/PRT



(NSN) 6625-01-136-9346) **8520/PRT**

8520A/PRT Temperature Measurement System

- -183°C to + 350°C (IPTS 68) range
- ±0.010°C accuracy - 100°C to + 100°C
- 0.001°C resolution
- Reading storage memory
- GPIB/IEEE-488 interface
- Onboard computational programs
- Full DMM capability

The 8520A/PRT is a temperature measurement system consisting of a special Rosemount* 162N Platinum Resistance Thermometer (PRT) and a Fluke 8520A 5-1/2 Digit Precision Digital Multimeter. The 8520A contains a built-in linearization program customized to match the calibration curve of the specific PRT supplied. Temperature is indicated directly in either °C, °F or K with 0.001° resolution.

The system provides a fast, low-cost way of making extremely accurate temperature measurements, or calibrating temperature measurement instruments, in the range of -183°C to +350°C. Systems using four-terminal resistance bridges are much more time-consuming to use, require greater expertise, are limited in their applications, and are far more costly.

Measurements are repeated approximately once per second, making it possible to detect and track fast temperature changes, something impractical to try to do with balance bridges.

162N PRT Characteristics

All PRTs exhibit hysteresis during temperature cycling, as with going from room temperature to boiling and back. The special 162N has a hysteresis of less than 0.001% of the temperature span. That is less than 1 mK for the entire thermometer range. This quality is not achievable in any industrial PRT.

Errors due to a change in ice-point resistance can be detected using a standard 100-ohm resistor (supplied), and the change can be compensated easily by changing the gain factor in a memory register of the 8520A. Such compensation is completely effective near 0°C, least effective near -110°C and +240°C, but predictable as a worst-case error at all temperatures within the range of -183°C to +350°C.

8520A Characteristics

The 8520A Digital Multimeter is compatible with GPIB/IEEE-488* instrument systems and has both built in and optional math power for a wide range of R&D and ATE applications other than temperature measurement and calibration. See page 77 for more information.

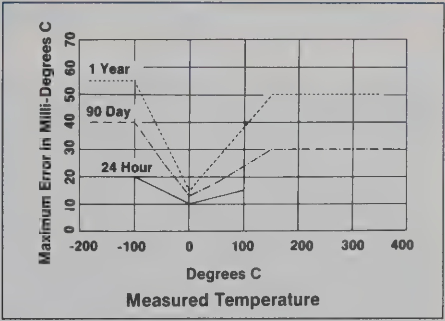
Accuracy

The temperature measurement accuracy of the 8520A/PRT system is shown graphically in the accompanying chart. Because accuracy depends on the stability characteristics of the 8520A as a function of both ambient temperature and time, 24-hour, 90-day, and 1-year accuracy curves are shown. The kind of accuracy you need will determine how often the 8520A should be calibrated.

The stability characteristics of the PRT are also very important and are influenced by time, how carefully it is used, and the kind of use it gets.

The 162N Probe is calibrated in liquid baths. No significant error due to self-heating will occur when measuring the temperature of liquids. A +12 mK error should be expected when measuring the temperature of gases.

Specifications



Probe Sheath: INCONEL-X750, 5.6 mm (0.219 in) diameter, 48 cm (19 in) length
Connector: Mates with 8520A/PRT
Power: 100, 120, 220, or 240V ac, ± 10%, 50 to 60 Hz, ≤50W
Size: 8.9 cm H x 47.7 cm L x 43.2 cm W (3-1/2 in H x 18 in L x 17 in W)
Weight: 9.56 kg (21 lb)

Ordering Information

Model	January 1989 prices
8520A/PRT Temperature Measurement System w/Probe	7350
Option	
8520A-010* Extended software pkg	600

*Rosemount® is a trademark of Rosemount, Inc.
Note: The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

2180A, 2189A & 2190A

GPIB
IEEE-488

RS-232

2189A Thermometry System

2180A, 2189A & 2190A TemPak Series

0.01° resolution for the 2180A and 2189A and 0.1° resolution for the 2190A
Capable of running off of 12V dc or ac line power
Designed to be integrated with a wide variety of instruments and accessories
°C of °F is selectable via a front panel switch
A full five digit LED display
Analog and digital (RS-232-C or GPIB/IEEE-488) output options are available
The limits option allows peak and valley memory, alarms and delta
The 2189A consists of a 2180A and plantinum RTD probe for greater accuracy
6 different RTD types are switch selectable. 4 platinum, 1 nickel, 1 copper (2180A)
15 different thermocouple linearizations including 2 DIN and 3 JIS standards (2190A)

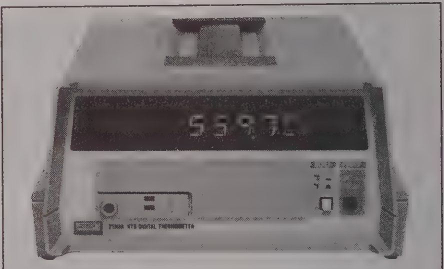
Fluke's most accurate and versatile general purpose digital thermometers are the 2180A and 2189A for RTDs and the 2190A for thermocouples. State-of-the-art accuracy teams with a large family of options and accessories to let you make precision temperature measurements in the lab or out in the field.

The 2180A RTD Digital Thermometer lets you switch-select one of six different types of RTDs, four platimum, one nickel, and one copper. Resolution is 0.01 degrees.

The 2189A Thermometry System consists of a 2180A that is factory-matched to a precision Y2039 Platinum RTD Probe.

The 2190A Thermocouple Digital Thermometer supports ten different thermocouple types, including two that comply to European DIN standards and three to Japanese standards. Resolution is 0.1 degrees. Take your choice from three different standard combinations of thermocouple types.

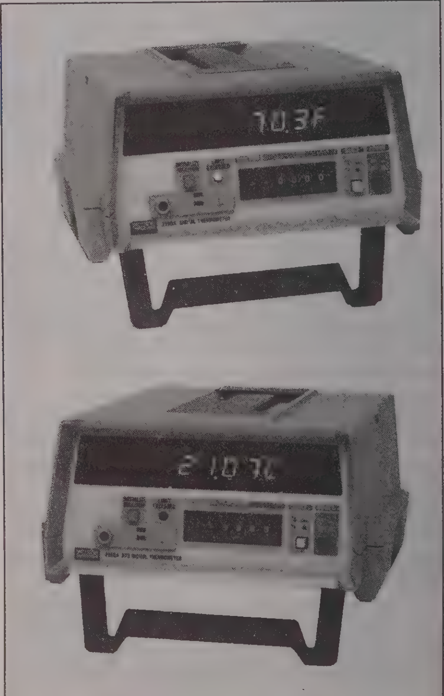
Each thermometer features a bright, high resolution LED display with pushbutton selection of Fahrenheit or Celsius readings. Each is capable of being run from either ac line power or external 12V dc, for field portability.



2180A without Option -006

Output Option -002, -004 and Limits Option -006 are usable with any of the three thermometers. Other accessory items electronically connect and stack and latch to the 2180A or 2190A. These include manual multipoints, multiple alarms, a battery pack, and a thermocouple thermometer calibrator. Some are also practical to use with the 2189A.

For automatic scanning, see the section on the 2300A Scanner. A 2020A or 2030A Printer allows you to permanently store data when used with a 2180A or 2190A configured with an output option. Portable temperature logging is available with the factory-tested Temperature Logging Systems — 2383A or 2393A.



2190A/2180A with Option -006

Limits Option (-006)

This option adds three powerful functions to the 2180A and 2190A Thermometers: Alarms, Peak Memory, and Delta. The Alarms function lights an indicator and closes a relay to activate external devices whenever a single preset maximum or minimum set-point is exceeded. Peak Memory stores the highest and lowest temperature reading for later recall. And Delta automatically subtracts a thumbwheel setting from the actual measurement and displays the difference.

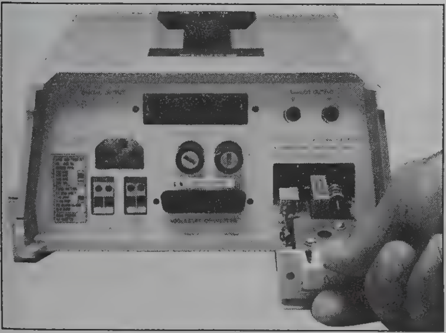
IEEE-488 Option (-004)

The 21X0-004 is an GPIB/IEEE-488* output option for the 2180A, 2189A and 2190A thermometers. This option mounts within the thermometer in the same location as the 21X0A-002. Readings are taken in response to an SRQ from the option by an IEEE-488 controller. This interface option does not include analog output capability. For applications requiring analog output and IEEE-488, use Option -002, 2XXXA-522, 1120A and Y7203. Not for use in a 2300A Scanner System.

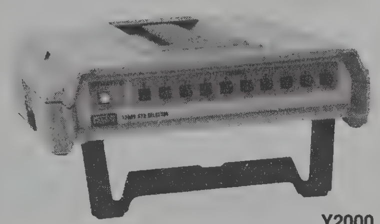
Output Option (-002)

For recording temperature measurements with a 2180A, 2189A, or 2190A, you can use Output Option -002. It provides both an analog output for chart recorders and a digital output for printers or computers, and may be installed in the field. The digital output is available in four forms, depending on connector pins and cabling used: Parallel ASCII, RS-232-C, TTY current loop, and IEEE-488 (using the Fluke 1120A Translator). The Y2026B RS-232-C Cable Adapter is available to convert the 36-pin PTI connector on the option to a standard 25-pin RS-232-C connector, or the user can wire his own cable to the connector provided.

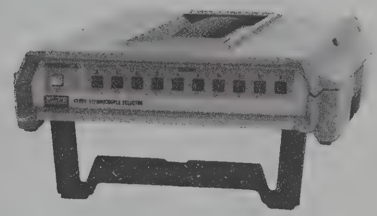
Option -002 is required when the thermometer is being used with a Fluke 2020A-004 or 2030A Printer unless a 2300A Scanner is used.



Rear view of 2190A showing the (A) Output Option -002 Connector, (B) Y2030 Thermocouple Input Module, and (C) Limits Option -006 Relay Output.



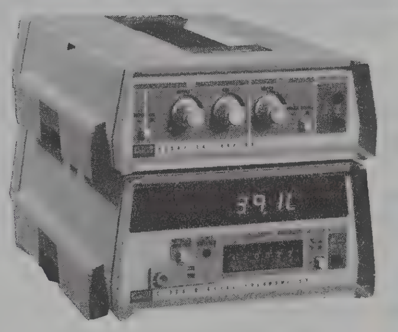
Y2000



Y2001

Multipoint Selector (Y2000 & Y2001)

The Y2000 RTD Multipoint Selector (for the 2180A) and the Y2001 Thermocouple Multipoint Selector (for the 2190A) increase the number of points your thermometer can monitor. Connect up to ten sensors to each multipoint selector. Cascade up to ten multipoint selectors for up to 100 measuring points—all using a single 2180A or 2190A Thermometer. Both units have ten pushbuttons to easily access a specific measurement point. To measure or monitor more than one type of RTD or thermocouple, take advantage of internal switching. This allows you to monitor five sensors of one type, five of another. With Output Option -002 or -004 installed, the channel number is sent to your printer or computer, too. For automatic scanning applications see the 2300A, 2383A and 2393A.

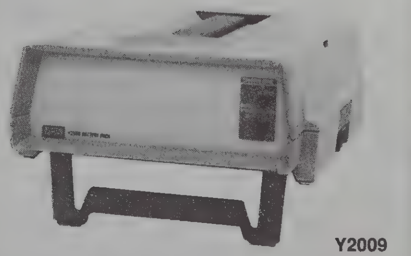


The 2190A/Y2003 Portable Calibration System

Thermometer Calibration (Y2003)

The Y2003 Thermometer Calibrator and 2190A Digital Thermocouple Thermometer can be used together to check the accuracy of a thermocouple or millivolt-measuring or recording instrument.

Accurate and completely portable, the Y2003-2190A combination provides a variable voltage output from -10mV to +90mV. The output voltage simulates a thermocouple output, so that the reading on the 2190A Thermometer can be compared with a corresponding reading on any other thermocouple thermometer, either analog or digital. In addition, the Y2003 and 2190A can be used to calibrate millivolt chart recorders and digital or analog indicators measuring to 90 mV. Besides being used as a portable calibration system, the Y2003 can be used as a battery pack for the 2190A. See Y2009 below for battery usage details. For more information ask for Bulletin B0059.



Y2009

Battery Pack (Y2009)

The Y2009 Battery Pack is a rechargeable, self-contained 12V dc nickel-cadmium supply for up to five hours of continuous operation. An indicator light tells you when batteries are low, while an automatic cut-off prevents damage to the cells from excessive discharge.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

2180A, 2189A & 2190A

Specifications

2180A & 2190A Specifications

2180A RTD Thermometer

RTD Types: 100Ω Pt, 385 (DIN), 390, 3916, or 392; 100Ω Ni (DIN); 10Ω Cu; 0 to 999Ω resistance — switch-selectable
Resolution: 100Ω Pt RTDs: 0.01°, autoranging to 0.1° above 204°C; 100Ω Ni RTDs: 0.01°, autoranging to 0.1° above 93°C; 10Ω Cu RTDs 0.1°.
Input Connection: 4-wire screw terminals. Terminals accept 3-wire and 2-wire RTDs at reduced accuracy
RTD Matching: User-performed potentiometer adjustment matches the 2180A to user's RTD to compensate for variations in lead length and resistance at 0°C
Lead Resistance: 4-wire: 200Ω max per lead for both 100Ω and 10Ω RTDs; 3-wire: 2Ω max per lead for 100Ω RTDs, 0.18Ω max per lead for 10Ω RTDs; 2-wire; 0.9Ω max per lead for 100Ω RTDs, 0.09Ω max per lead for 10Ω RTDs
Lead Resistance Error: 4-wire; no error, 3-wire 100Ω RTDs: 0.012° per degree per ohm; 3-wire 10Ω RTDs: 0.12° per degree per ohm; 2-wire 100Ω RTDs: 0.025° per degree per ohm; 2-wire 10Ω RTDs 0.25° per degree per ohm

2180A Linearizations (Type 2)*

RTD Type	Linearization Coefficients
100Ω 385 Pt	DIN**43760 Table
100Ω 390 Pt	ALPHA* = 0.0038994 DELTA* = 1.494 A4* = -0.265668×10^{-4} C4* = $-0.205984 \times 10^{-11}$
100Ω 3916 Pt	ALPHA* = 0.003916 DELTA* = 1.505 A4* = -0.099668×10^{-5} C4* = $-0.271142 \times 10^{-12}$
100Ω 392 Pt	ALPHA* = 0.0039221 DELTA* = 1.493 A4* = -0.38668×10^{-5} C4* = $+0.192912 \times 10^{-13}$
100Ω 617 Ni	DIN** 43760 Table
10Ω*** Cu	RO = 9.042 Ohms R25 = 10.005 Ohms ALPHA = 0.004260

*See IPTS 68 equations in NBS Monograph 126. Type 1 no longer available.
**European Standard.
***Contact factory for information on the 2180A/AT for 10Ω, 3 wire applications.

2180A Accuracy (Type 2)* (Celsius)

RTDs		Maximum Error* ±Degrees C		
Type	Applicable Portion of Temperature Range °C	At Cal	90 Days 20°C to 30°C	1 Year 15°C to 35°C
100Ω	-190 to 0 0 to 204	0.043 0.043	0.089 0.132	0.112 0.173
385 Pt	-190 to 0 0 to 750	0.11 0.11	0.12 0.26	0.14 0.37
100Ω	-200 to 0 0 to 204	0.009 0.009	0.055 0.098	0.078 0.139
390 Pt	-200 to 0 0 to 750	0.08 0.08	0.10 0.23	0.11 0.32
100Ω	-200 to 0 0 to 204	0.040 0.040	0.086 0.13	0.109 0.171
3916 Pt	-200 to 0 0 to 750	0.11 0.10	0.12 0.26	0.14 0.34
100Ω	-200 to 0 0 to 204	0.008 0.009	0.055 0.098	0.078 0.139
392 Pt	-200 to 0 0 to 750	0.08 0.08	0.10 0.23	0.11 0.32
100Ω	-60 to 0 0 to 93	0.129 0.129	0.157 0.176	0.172 0.199
617 Ni	-60 to 0 0 to 177	0.19 0.19	0.20 0.22	0.21 0.25
10Ω Cu	-75 to 0 0 to 150	0.16 0.16	0.18 0.20	0.19 0.23
Ohms	0 to 196.99 0 to 999.99	0.005 0.05	0.042 0.22	0.059 0.31

2180A Accuracy (Type 2)* (Fahrenheit)

RTDs		Maximum Error* ±Degrees F		
Type	Applicable Portion of Temperature Range °F	At Cal	90 Days 20°F to 30°F	1 Year 15°F to 35°F
100Ω	-309.9 to 32 32 to 399.2	0.076 0.076	0.161 0.239	0.203 0.314
385 Pt	-309.9 to 32 32 to 1382.0	0.18 0.18	0.21 0.46	0.24 0.62
100Ω	-327.9 to 32 32 to 399.2	0.015 0.015	0.100 0.177	0.142 0.252
390 Pt	-327.9 to 32 32 to 1382.2	0.13 0.13	0.16 0.41	0.19 0.57
100Ω	-327.9 to 32 32 to399.2	0.071 0.071	0.156 0.234	0.198 0.309
3916 Pt	-327.9* to 32 32 to 1382.2	0.17 0.17	0.21 0.46	0.24 0.62
100Ω	-327.9 to 32 32 to 399.2	0.014 0.014	0.099 0.177	0.141 0.252
392 Pt	-327.9 to 32 32 to 1382.2	0.12 0.12	0.16 0.41	0.19 0.57
100Ω	-76 to 32 32 to 199.4	0.230 0.231	0.282 0.317	0.308 0.359
617 Ni	-76 to 32 32 to 350.6	0.33 0.33	0.39 0.39	0.35 0.44
10Ω Cu	-103 to 32 -103 to 302	0.27 0.27	0.31 0.35	0.34 0.41
Ohms	.005 .05	All units In Ohms		

Note: Shaded area is 0.01° resolution; unshaded area is 0.1° resolution.
**Total instrument accuracy. Does not include RTD probe errors. Valid for 4-wire RTDs only.*
Microcomputer Type 1 no longer available.

2189A Thermometry System

Includes Platinum RTD Probe Y2039 and a 2180A RTD Thermometer.

Maximum System error (±°C)

Temp. °C	At Calibration	90 Days 18°C-28°C Ambient	1 Year 18°C-28°C° Ambient
Low Temperature Range...			
-183	(1)	(1)	(1)
-50	0.04	0.08	0.11
0	0.03	0.07	0.09
50	0.05	0.10	0.13
100	0.07	0.12	0.16
150	0.08	0.15	0.20
200	0.09	0.17	0.23
High Temperature Range...Periodic probe exposure*			
204	0.14	0.25	0.27
300	0.18	0.32	0.33
400	0.21	0.39	0.40
480	0.29	0.48	0.50

(1) The system operates down to -183°C but the probe calibration is not verified below -50°C. It is estimated that the accuracy below -50°C is the same as the accuracy at an equal temperature in the positive range. Low temperature calibrations are available as a special.
**Accuracy above 200°C is based on the user performing an Ice Point adjustment in accordance with the following schedule:*

Probe Exposure Temperature Range	Total Exposure Time Before Adjustment
200°C t0 350°C	500 hours
350°C to 480°C	250 hours

Exposure of the Y2039 at high temperatures for long periods of time may cause the probe to change its characteristics and require the accuracy specifications to be degraded. For example, there is a 20% probability that exposure at 480°C for 500 hours will require degrading. It is easy for the user to determine if degrading is necessary by measuring the Ice Point resistance of the probe. The 2189A Instruction Manual explains this degrading procedure.

2190A Specifications

Thermocouple Types: Five, switch-selectable. Which thermocouple types depends on your choice of microcomputer type. See Accuracy chart below.

2190A Accuracy* (Celsius)

RTDs		Maximum Error*		
		±Degrees C		
Type	Applicable Portion of Temperature Range °C	At Cal	90 Days 20°C to 30°C	1 Year 15 C to 35°C
Type 1				
J	-128 to 0 0 to 900	0.18 0.18	0.19 0.31	0.21 0.36
K	-132 to 0 0 to 1350	0.18 0.18	0.19 0.39	0.21 0.47
T	-243 to 0 0 to 400	0.18 0.18	0.20 0.22	0.22 0.25
R	0 to 1708	0.31	0.59	0.70
C**	0 to 2471	0.18	0.60	0.75
Type 2				
J	-128 to 0 0 to 900	0.18 0.18	0.19 0.31	0.21 0.36
K	-132 to 0 0 to 1350	0.18 0.18	0.19 0.39	0.21 0.47
E	-252 to 0 0 to1000	0.18 0.18	0.20 0.33	0.22 0.39
R	0 to 1708	0.31	0.59	0.70
S	0 to 1685	0.22	0.50	0.60
Type 3				
J DIN**	-100 to 0 0 to 760	0.18 0.18	0.19 0.28	0.20 0.33
K	-50 to 0 0 to 1372	0.18 0.18	0.18 0.39	0.20 0.48
T DIN**	-200 to 0 0 to 400	0.18 0.18	0.20 0.22	0.21 0.25
B	420 to 1815	0.21	0.52	0.62
R	140 to 1700	0.18	0.46	0.46

2190A Accuracy* (Fahrenheit)

RTDs		Maximum Error*		
		±Degrees F		
Type	Applicable Portion of Temperature Range °F	At Cal	90 Days 20°F to 30°F	1 Year 15°F to 35°F
Type 1				
J	-198 to 32 32 to 1652	0.20 0.20	0.23 0.47	0.26 0.58
K	-206 to 32 32 to 2462	0.30 0.30	0.33 0.72	0.37 0.87
T	-405 to 32 32 to 752	0.30 0.30	0.35 0.41	0.39 0.46
R	32 to 3106	0.47	1.01	1.20
C**	32 to 4480	0.30	1.11	1.37
Type 2				
J	-198 to 32 32 to 1652	0.20 0.20	0.23 0.47	0.26 0.58
K	-206 to 32 32 to 2462	0.30 0.30	0.33 0.72	0.37 0.87
E	-422 to 32 32 to 1832	0.30 0.30	0.33 0.61	0.40 0.72
R	32 to 3106	0.47	1.01	1.20
S	32 to 3065	0.38	0.92	1.10
Type 3				
J DIN**	-148 to 32 32 to 1400	0.30 0.30	0.32 0.52	0.36 0.61
K	-58 to 32 32 to 2502	0.20 0.20	0.22 0.63	0.25 0.78
T DIN**	-328 to 32 32 to 752	0.30 0.30	0.34 0.41	0.38 0.46
B	788 to 3299	0.37	0.95	1.15
R	284 to 3092	0.20	0.74	0.93

** Total instrument accuracy. Does not include Thermocouple errors*
*** C designates Tungsten-5% Rhenium vs. Tungsten 26% Rhenium*
**** DIN 43710, a European Standard until 1984*

Resolution: 0.1°C, °F
Input Connection: 2 wires on screw terminal isothermal block
Max Source Impedance: 2 kΩ
Overrange Detection: Flashing display
Open Circuit Detection: Source impedance of 3 kΩ or more causes of flashing "0C"
Repertoire: SH1, AH1, T6, LO, SR1, RLO, PPO, DC0, DT0, C0, E2
Service Request Usable: Yes
Power: Operates only when powered by AC line

2190A/AM Thermocouple Thermometer

The 2190A/AM is a modified 2190A thermometer with fifteen thermocouple linearizations instead of the standard five. The user can select any of the 15 thermocouple types by adjusting the configuration of a multiswitch. The Model 2190A/AM provides all of the benefits of the standard 2190A in accuracy and system capability. The 2190A/AMK is a kit for retrofitting existing 2190As. The 2190A/AM offers the Japanese (JIS) series and European (DIN) of linearizations as well as the U.S. N and D linearizations.

Specifications are equivalent to those of the standard 2190A. Thermocouple Types Supported: NBS types (J,K,T,C,R,E,S,B,N,D), DIN types (J,T), JIS Types (J,K,R)

Option Specifications

Output Option (-002)

Analog Output
Type: Linearized and isolated
Voltage: 1.0 mV/°C or °F to 5 mA max
Temperature Coefficient: 200 ppm/°C from 25°C
Noise: ≤100μV at 100 Hz bandwidth
Accuracy: ±0.1% of reading ±1mV
Drift: 200μV/°C from 25°C
Overload or Open Circuit: Zero volts via banana jacks

Digital Output
Types: Four, E.I.A. Standard RS-232-C, TTY current loop, parallel ASCII, and Fluke PTI
Connector: 36-pin AMP "Champ"
Serial Baud Rates: 110, 150, 300, 600, 1200, 2400, 4800, or 9600, switch-selectable
RS-232-C Signals: Transmitted Data, Request to Send, Clear to Send, Data Set Ready, Signal Common
Parallel ASCII Signals: Data: 8 lines; Instrument Address: 4 lines; Address Valid; Data Valid; Acknowledge: Ground; +5V
TTY Current Loop Signals: Source and controlled sink, 20 mA
Out-of Limit Signals: Exclamation point transmitted with Option -006 only

Limits Option (-006)

Limits Function: Lights LED and activates form A (SPST) reed relay when thumbwheel setpoint is exceeded. Reed relay rated 10 VA, 184V dc or 130V ac rms max, 0.5A max, resistive, Selectable either low (≤) or high (≥)
Min/Max Function: Continuously stores Min and Max temperature
Delta Function: Displays difference between thumbwheel setpoint and actual temperature
Thumbwheels: 6, for function, sign, and setpoint (±9999). Setpoint resolution is 1 degree.

Accessory Specifications

Y2000 RTD Multipoint Selector

Channels: Ten per Y2000, up to ten Y2000s per 2180A. Channel number sent to printer or computer when Output Option -002 or -004 are used
RTD Types: Same as 2180A. Two types per Y2000
Power: Supplied by 2180A
Interfacing: Attached 46-cm cable plugs into rear of 2180A or Y2002. Receptacle accepts cable chained from other Y2000s
Size and Weight: Style A PTI case, 1.4 kg (3.09 lb)

Y2001 Thermocouple Multipoint Selector

Channels: Ten per Y2001, up to ten Y2001s per 2190A. Channel number sent to printer or computer when OUtput Option -002 or -004 are used
Thermocouple Types: Same as 2190A. Two types per Y2001
Maximum Voltage Between Channels: 125V ac rms
Power: Supplied by 2190A
Interfacing: Attached 46-cm cable plugs into rear of 2190A or Y2002. Receptacle accepts cable chained from other Y2001s
Size and Weight: Style A PTI case, 1.6 kg (3.53 lb)

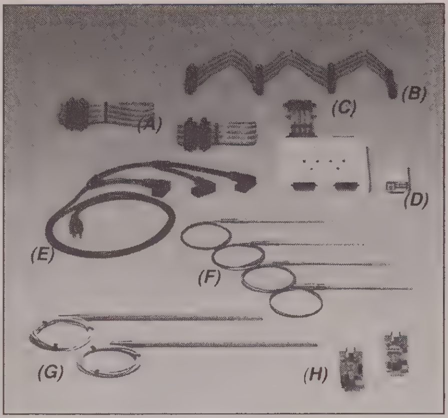
Y2003 Thermocouple Calibrator and Battery Pack

Thermocouple Types: Same as 2190A
Output Voltage: -10 mV to +90 mV, adjustable. Applied at input terminals of 2190A and thermocouple thermometer of less accuracy to be calibrated
Adjustments: Coarse, fine and offset
Battery Pack: Same specifications as Y2009
Interfacing: Attached 46-cm cable plugs into rear of 2190A
Size and Weight: Style B PTI case, 2.6 kg (5.74lb)

Y2009 Rechargeable Battery Pack

Output: 12V dc, 750 mA max
Battery: Ten 1/2-D size cells in drip-proof case
Operating Time: 5-6 hours typical at 25°C on full charge when connected to 2180A, 2190A
Recharge Time: 16 hours typical at 25°C
Charger: Built-in-on-off-switch, low-battery automatic discharge cut-off
Output Connectors: Rear panel screw terminal block
Operating and Storage Temperature: 0°C to 40°C
Power: 100, 120, 220, or 240V ac±10% selectable, 50 to 400 Hz; 10W, typical
Size and Weight: Style B PTI case, 2.5 kg (5.52 lb), typical

A Family of Accessories



*Small accessories shown are: **(A)** Y7203 and Y7204 PTI Polling Cables, **(B)** Y2036 3-Module PTI Polling Cable, **(C)** Y2026 Cable/Adapter, **(D)** Y2022 Calibration Divider, **(E)** Y2024 3-Module Power Cord, **(F)** P20-Series Thermocouple Probes, **(G)** Y2037 and Y2039 RTD Probes, **(H)** Y2030 and Y2031 Plug-In Modules.*

Y2022 Thermometer Calibration Divider (D in Picture)

Function: Either precision resistor or voltage divider (÷10 or ÷100)
Input Voltage: 0-10V dc
Output Impedence: 100Ω
Precision Resistor: 100Ω±0.01Ω, temp coefficient 5 ppm

Y2024 3-Module Power Cord (E in Picture)

Connects three PTI-family instruments or accessories to single 120V ac power outlet

Y2026B RS-232-C Cable Adapter (C in Picture)

Function: Routes RS-232-C signals from 36-pin PTI connectors to 25-pin RS-232-C connectors
Connections: Two 36-pin PTI connectors (M and F), two 25-pin RS-232-C connectors (M and F). Y7203 cable supplied
RS-232-C Pin Selections: Slide switches. Select TD on pin 2 or 3; DTR, DSR and CTS, through or pulled up; Scanner busy, through or to CTS

Y2030 Plug-in Module (H in Picture)

Extra plug-in units for 2190A thermocouples. Leave attached to input wire-pair for easy interchange of thermocouple inputs.

Y2031 Plug-in-Module (H in Picture)

Extra plug-in unit for 2180A RTDs, leave attached to input wires for easy interchange of RTD inputs.

Y2036 PTI Polling Cable (B in Picture)

Connects up to three PTI-family measurement instruments to 2020A or 2030A Printer.

Y2037 Platinum RTD Probe (G in Picture)

Resistance: 100Ω ± 0.1Ω at 0°C
Temperature Range: -80°C to +480°C
Curve Conformity: ±0.1% of temperature using IPTS 68 with ALPHA = 0.0038994 and DELTA = 1.494
Stability: Periodic usage (20% of time) ±0.03°C if used from 0°C to 200°C and ±0.22°C if used from -80°C to +480°C
Hysteresis: Less than ± 0.08°C when using 0°C and 200°C as end points
Immersion Effects: ±0.005°C when going from 4 inches to 10 inches in an ice bath Transition End Temperature: 150°C maximum
Physical: 316 SS Sheath, 0.25 in diameter x 12 in L; four 6 ft leads #22 AWG stripped and tinned
Handling: Contains strain-free platinum coil. Must be handled with care.

Y2039 Platinum RTD Probe (G in Picture)

Probe resistance: 100Ω ± 0.1Ω at 0°C
Temperature Range: -183°C to +480°C
Performance Standard: R100° /RO° = 1.3922, nominal. Conforms to IPTS 68 within 0.03% of temperature from -50°C to 420°C using ALPHA = 0.0039221 and DELTA = 1.493
Resistance Stability: 12 mΩ/year when exposed at 200°C or 20 mΩ in 250 hours when exposed at 480°C measured with probe at 0°C. 4 mΩ = 0.01°C + 0.04% of temperature
Hysteresis: Less than 0.01°C at 200°C when using 0°C and 420°C as end points
Immersion Effects: The readings shall not vary more than 0.005°C when probe is varied from 4 to 10 inches in an ice bath
Transition End Temperature: 150°C maximum
Time Constant: 8 seconds maximum when tested in flowing water at 3 feet per second
Sheath Material: INCONEL
Size: Diameter 0.64cm (0.25 in), length 30.5 cm (12 in)
Leads: 4 wires, 6 ft, #22 AWG, ends stripped and tinned
Calibration: Each probe is calibrated at 0°C, 200°C and 420°C. The IPTS 68 constants R0, ALPHA, DELTA and A4 are provided
Handling: Contains strain-free platinum coil. Must be handled with care

2180A, 2189A & 2190A

PTI Case Dimensions

Style	Height	Width	Depth
A	5.7 cm (2.25 in)	20.5 cm (8.05 in)	32.6 cm (12.85 in)
B	8.2 cm (3.23 in)		
C	10.5 cm (4.13 in)		
D	12.8 cm (5.03 in)		

General Specifications

Display: °F or °C, switch-selectable; 7 segment 1.1 cm LED
Measurement Method: Dual-slope integration, 100ms integration time, 3.33 readings/second
Linearization Technique: Segmented 4th order curve fit
Temperature Coefficient: ±15ppm/°C from 25°C
Stability: 175 ppm/90 days, 200 ppm/year
Common Mode Voltage: 350V dc, 250V rms ac, max
Common Mode Noise Rejection: ≥160dB at 50, 60, and 400 Hz ± 0.1% 100Ω unbalance
Normal Mode Noise Rejection: ≥90dB at 50, 60 and 400 Hz ± 0.1%
Drift: None, automatic zero correction
Input Impedence: 1000 MΩ at dc
Accessory Connector: 25-pin rear panel receptacle interfaces thermometer to Y2000, Y2001, Y2003, and 2300A
Shock and Vibration: Meets MIL-T-28800C, class 3 specifications
Ambient Temperature: 0°C to 50°C operating, -40°C to 75°C non-operating
Relative Humidity: ≤80% from 0°C to 50°C non-condensing
Power: 12V dc or 100, 120, 220, 240V ac ± 10% selectable, 50 to 400 Hz; 8W typical
Size: Style C PTI case, 10.5 cm H x 20.5 cm W x 32.6 cm D (4.13 in H x 8.05 in W x 12.85 in D)
Weight: 2.1 kg (4.63 lb)
Safety: (2180A and 2190A only) Factory Mutual 3820 approved, CSA 556B certified
Included: Instruction manual, power cord. Probes are not included except with 2189A

Ordering Information

Models

January 1989 prices

RTD Thermometers

2180*	$1135
2189A System	1850

** Contact factory for 3-wire 10Ω copper applications*

Thermocouple Thermometers

2190A Type 1 — J,K,T,R,C	1085
2190A Type 2 — J,K,E,R,S	1085
2190A Type 3 — J(DIN), K,T (DIN),B,R	1085
2190A/AM (15 types)	on req
2190A/AMK (15 types) Upgrade Kit for 2190A	on req

Also see page 452, 2383A and 2393A Temperature Logging Systems

Options (for 2180A, 2189A, 2190A)

-002* Analog and Digital Output	395
-004** IEEE-488 Output	450
-006 Limits	265

Note: Above options are customer installable
**Required for compatibility with 2020A-004 or 2030 Printer or 1120A Translator. However, the option is not required when the thermometer is used with a 2300A Scanner, unless analog output is also needed.*
***Cannot be used with Option -002*

Accessories (Also see page 485)

Used for 2190A

P20J* Thermocouple Probe	63
P20K* Thermocouple Probe	63
P20T* Thermocouple Probe	63
P20E* Thermocouple Probe	63
Y2001 Multipoint Selector for Thermocouples	635
Y2003 Thermocouple Calibrator/ Battery Pack	685
Y2022 Thermometer Calibration Divider	130
Y2030 Thermocouple Input Module	95

Used for 2180A & 2189A

Y2000 Multipoint Selector for RTDs	$635
Y2031 RTD Input Module	95
Y2037 RTD Probe 100Ω 390PT	260
Y2039 RTD Probe 100Ω 392PT	700

Joint Accessories

Y2009 Battery Pack, Rechargeable	440
Y2014** 5-1/4" Rack Mount Kit PTI, Single, Size C, Offset	95
Y2015** 5-1/4" Rack Mount Kit PTI, Double, Size C	95
Y2020** 4.80 DIN Panel Mount Kit PTI	95
Y2026B RS-232- Cable Adapter	180
Y2024 3-Module Power Cord	21
Y2036 PTI Polling Cable	83
Y7203 2-ft 36-pin PTI Cable	55
Y7204 5-ft 36-pin PTI Cable	70

**See page 442 for specifications*
***See page 485 for other size PTI rack mount kits and panel mount kits*

Also see 2030A Printer/Plotter, page 456; 2300A Scanner, page 450 and IEEE-488 Translator, page 361.

Service and Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2180A Repair (w/ calibration)	126
SC1-2180A Repair (cal w/ in or out data)	161
SC1-2180A Repair (cal w/in and out data)	196
SC2-2180A Cal (1/yr recommended)	63
SC2-2180A Cal (1/yr w/in or out data)	98
SC2-2180A Cal (1/yr w/in and out data)	133
SC1-2189A Repair (w/ calibration)	134
SC1-2189A Repair (cal w/ in or out data)	169
SC1-2189A Repair (cal w/in and out data)	204
SC2-2189A Cal (1/yr recommended)	72
SC2-2189A Cal (1/yr w/in or out data)	107
SC2-2189A Cal (1/yr w/in and out data)	142
SC1-2190A Repair (w/ calibration)	110
SC1-2190A Repair (cal w/ in or out data)	145
SC1-2190A Repair (cal w/in and out data)	180
SC2-2190A Cal (1/yr recommended)	63
SC2-2190A Cal (1/yr w/in or out data)	98
SC2-2190A Cal (1/yr w/in and out data)	133

2300A (TemPak Series)

GPIB IEEE-488

RS-232

2300A

2300A Temperature Scanner

- Can be used with either thermocouples or RTDs
- Capable of scanning 20 points
- Expandable to 100 points with the 2301A Extender Chassis
- Scanning can be either manually or automatically with a set interval time
- Unused channels can be skipped through a switch setting
- Two interface options. One provides remote programming capabilities
- LED display specifies the channel being monitored
- Two different types of thermocouples or RTDs can be used per input card
- Capable of running off of 12V dc or ac line power

The 2300A Temperature Scanner is designed to be used with either a Fluke 2180A or 2190A Digital Thermometer to sequentially scan and read the temperature of up to 20 RTDs or thermocouples. For even more capacity, a 2301A Scanner Extender can be added to scan an additional 30 sensors. Two 2301s may be stacked and latched together to scan up to 80 channels and a third may be added to scan up to 100 channels.

Scanning may be done one channel at a time manually, with keystrokes at the front panel, or automatically. Readings also may be printed at pre-selected intervals using either a Fluke 2030A Computing Printer or a 2020A Universal Interface Printer with the relevant options. All of these instruments are packaged in Fluke stack-and-latch cases that quickly and easily fit together to become an integrated, multichannel, temperature scanning and logging system. Using a 12V battery, a system may be operated in the field, away from any ac power source.

For preconfigured Temperature Logging System, see the 2382A and 2393A.

For applications that need mixtures of thermocouples, RTDs, dc voltages, 4 to 20 mA control loops, or contact closures, etc., see the 2280 Series Data Loggers on page 399.

Scanner Card Options (-002 & -003)

Both the -002 Thermocouple Scanner Card option and the -003 RTD Scanner Card Option provide for 10 sensor inputs. The inputs are divided into two blocks of five, so two different thermocouple types (or two different RTD types) may be used with each card. A switch allows you to automatically skip any unused channels, or you may skip them from the front panel of the Scanner.

Up to two cards (20 channels) may be housed in a 2300A Scanner, and up to three cards (30 channels) in a 2301A Scanner Extender. At least one scanner card is required for the 2300A to operate. Thermocouples and RTDs may not both be scanned at the same time by one 2300A.

Interface Card Option (-006)

This option will interface to either a 2180A or 2190A, and provide RS-232-C output for communication to external printers or computers. Option -006 allows remote control of the Scanner via either a bi-directional RS-232-C link or via the GPIB/IEEE-488* bus (with the 1120A Translator). No interface option is required for a 2301A Scanner Extender.

The Y2026B RS-232-C Cable Adapter is available to connect the 36-pin connector on the back of the Scanner to a cable with a standard 25-pin connector. Or you can wire your own cable to the connector provided.

Specifications

Technical Specifications

Channel Capacity: 10 or 20 channels in a 2300A; 10, 20, or 30 channels in each 2301A Extender Chassis; 100 channels per system, maximum. Each system to scan only RTDs (2180A) or only thermocouples (2190A)

Front Panel Programming: Automatic or Manual Scanning, Channel Skips, Channel Delay Time, Fast Forward, Fast Reverse

Display: Two digits, 00 through 99; either channel number or channel delay time

Channel Delay Time: Time interval between scanner relay contact closure and scanner trigger signal that initiates measurement instrument reading. Programmable from 0.0 to 8.0 seconds, 2 seconds or greater required for rated accuracy

Printer Control of Scan Interval: Either the 2020A Printer (with Option -004 and -006) or the 2030A Printer can be programmed to control the time between each scan cycle when connected to the 2300A

Scan Speed: Dependent on measurement instrument and application

Required Options: One Interface Option (-006) and at least one Scanner Card Option (-002 or -003). Also, one to three scanner card options per 2301A Extender Chassis if the 2300A is needed.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

IEEE-488 System: Requires 1120A Translator with Option 2XXXA-522 installed and Y7203 PTI cable:
RS-232-C Compatibility: Y2026B Cable/Adapter recommended

Option Specifications

Thermocouple Scanner Card Option (-002)

Input Channels: 10
Input Connections: Two wires per channel on screw terminal isothermal block
Thermal Offset Error: 1 microvolt, max
Channel Switches: 2-pole reed relays
Max Input Voltage: 170V dc or peak ac
Max Common Mode Voltage: 350V dc or peak ac between any two channels or between the cahssis and a channel
Thermocouple Types: See 2190A Thermometer Specifications
Switch-selectable Types: Two; five channels per thermocouple type
Reference Junction Compensation: Temperature-sense transistor on scan card isothermal block is used to send isothermal block temperature to 2190A for automatic ice point compensation

RTD Scanner Card Option (-003)

Input Channels: 10
Input Connections: 4-wire screw terminal
Thermal Offset Error: 10 microvolts max
Channel Switches: 3-pole reed relays
Max Input Voltage: 30V dc or peak ac
RTD Types: See 2180A Specifications
RTD Types Selectable: Two; five channels per RTD type

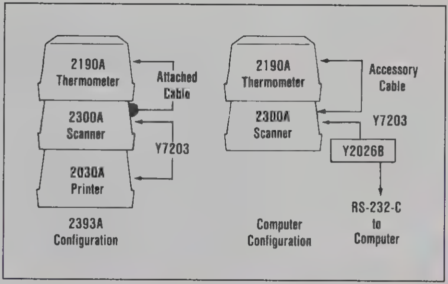
Interface & Remote Control Option (-006)

Option -006 provides the capability to be remotely programmed via the 1120A IEEE-488 Translator or RS-232-C terminal
I/O Connections: Interface Option -006 includes an attached accessory cable with a 25-pin male connector that plugs into the back of a 2180A or 2190A Digital Thermometer. The Option also provides a rear panel 36-pin connector for outputs to printers and computers.
36-Pin Connector: the Portable Test Instrument (PTI) connector is used to transfer information from a 2300A Scanner and 2180A or 2109A Thermometer to a printer, RS-232-C device, or IEEE-488 bus via the Fluke 1120A translator. The output information is: Channel number, temperature value, termperature scale (°C or °F), open circuit symbol, overrange symbol, limit-exceeded symbol (if 2180A or 2190A has Option -006), carriage return (CR), and line feed (LF). AY7203 Accessory cable is required for connecting a printer or 1120A Translator. AY2026B Cable/Adapter is strongly recommended for transmitting RS-232-C signals.
Signals: RS-232-C Transmitted Data, Request to Send, Clear to Send, Data Set Ready, Data Terminal Ready, Received Data, Received Line Signal Detector, Scanner Busy Ground, Source and Controlled Sink of 20 mA for TTY current loop operation (not used for programming commands). Baud rates are 110, 150, 300, 600. 1200, 2400, 4800, or 9600, switch-selectable.
IEE-488 Signals: All IEEE Std 488-1978 signals when used with 1120A Translator with Option 2XXXA-522 installed. Interface functions SH1, AH1, T6, L4, SR1 can be implemented.
Remote Programming: The 2300A accepts commands for programming channel delay time, channel skips, monitor channel, first and last channel single scans, and first and last channel continuous scanning. Programming is activated by sending command character codes on data line of IEEE-488 bus via the 1120A Translator or on the Received Data line via an RS-232-C device

Command	**Characters & Meanings**
ESC	Toggle Interface Direction
R	Place Scanner in Remote Control
L	Place scanner in Local Control
D mm	Set channel delay time to m.m seconds
S mm-nn	Skip channels mm to nn
U mm-nn	Unskip channels mm to nn
M mm	Monitor channel mm
A mm-nn	Continuously scan from channel mm to nn
X mm-nn	Make a single scan from channel mm to nn
RP	Print Scan Mode
MP	Print current channel
AP	Print first and last channels
XP	Print first and last channels
DP	Print channel delay

General Specifications

Ambient Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤75% to 50°C, operating; -20°C to +70°C, non-operating
Safety: IEC 348 Protection Class I, solely as it relates to insulation or grounding properties
Power
2300A: 100 to 130V ac or 200 to 260V ac, switch-selectable, 50 to 60 Hz, or 12V dc, 8 Watts
2301A: Supplied by the 2300A Scanner mainframe
Size: Style D PTI case, 13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in x 8.05 in x 12.85 in) both 2300A and 2301A
Weight
2300A: Approximately 3.6 kg (8 lb) depending on the options
2301A: Approximately 2.7 kg (6 lb) depending on the scanner cards installed
Included
2300A: Instruction manual, power cord, attached cable for 2180A or 2190A
2301A: Instruction manual, attached cable for 2300A or another 2301A



Ordering Information

Models

January 1989 prices

2300A Scanner	$700
2301A Extender Chassis	440

Interfacing a 2300A Scanner/2180A/2190A Thermometer combination to the IEEE-488 Bus requires a Y7203 or Y7204 Cable, the 1120A Translator and the 2XXXA-522 Personality Card. The 21X0A-002 or 21X0A-004 thermometer options are not required.

Options (for 2300A and 2301A)

-002 Thermocouple Scanner Card	435
-003 RTD Scanner Card	435
-006*Interface, Output and Remote Control	650

**Includes attached ribbon cable for 2180A or 2190A. For factory or Service Center installation only.*

Accessories

1120A IEEE-488 Translator	590
2XXXA-522* Personality Card for 1120A	405
Y2016 7" Rack Mount Kit PTI, Single	95
Y2017 7" Rack Mount Kit PTI, Double	95
Y2021 5.7" DIN Panel Mount Kit PTI	95
Y7203 36-Pin PTI Cable, 2ft	55
Y7204 36-Pin PTI Cable, 5ft	70
Y2026B RS-232-C Cable Adapter	180

**Required with 1120A Translator for IEEE-488 compatibility. Y7203 or Y7204 Cable also required.*

Service and Support

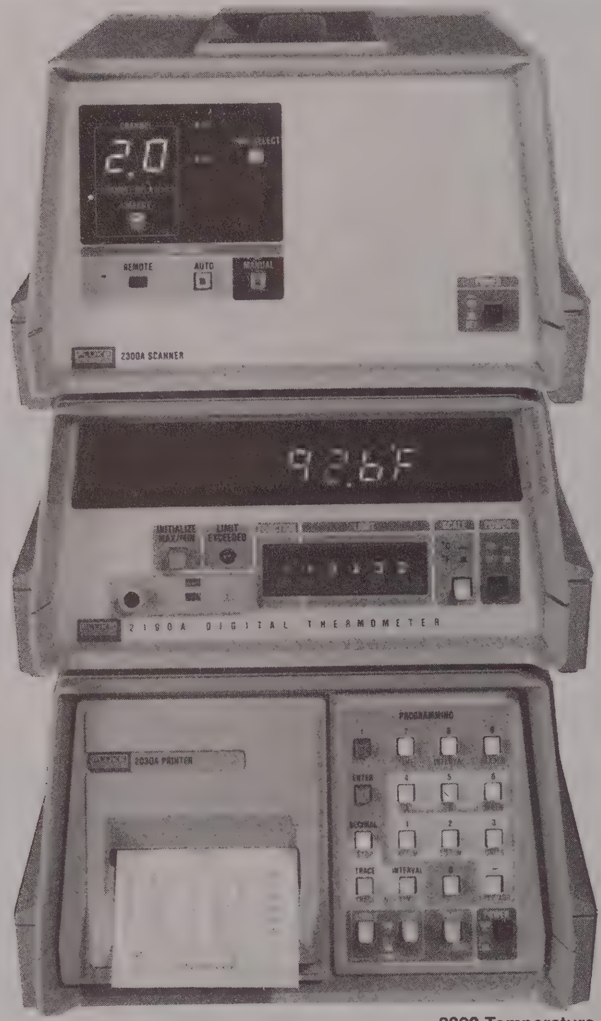
Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2300A Repair (w/calibration)	130
SC1-2300A Repair (cal w/in or out data)	145
SC1-2300A Repair (cal w/in & out data)	160
SC2-2300A Cal (1/yr recommended)	31
SC2-2300A Cal (1/yr w/in our out data)	46
SC2-2300A Cal (1/yr w/in & out data)	61

2383A/2393A (TemPak Series)



2393 Temperature Logging System

2383A & 2393A Temperature Logging System

- Completely configured and tested temperature logging systems
- Capable of running off of 12V dc
- Capable of scanning 20 points, and expandable to 100 points with the 2301A Extender Chassis
- Scan either manually or automatically with a set interval time
- The 2300A Printer with your choice of either RTD or thermocouple capability
- Six different RTD types are switch-selectable. Four platinum, one nickel, one copper, (2383A only)
- Ten different thermocouple linearizations are supported including two DIN standards, (2393A only)

Two portable, factory-integrated and tested temperature logging systems are available. They offer a choice of thermocouple or RTD measurements and a 2030A Printer. Temperature information from up to 10 sources may be logged using either of the two systems, or up to 20 by ordering one additional scanner option (-003 for RTDs or -002 for thermocouples). And each system may be expanded to monitor up to 100 points. Although the component parts may be ordered separately and assembled by the user, choosing the right combination of instruments, options, cables, etc., for your application is simplified by purchasing one of the systems. There is even a modest price advantage in purchasing a factory-tested system. Each offers the most accurate temperature logging capability that Fluke manufactures.

For applications that need mixtures of thermocouples, RTDs, dc voltages, 4 to 20 mA control loops, or contact closures, etc., see the 2280B Series Data Loggers on page 399.

The following chart shows the component parts of the two systems.

System Components

Items Included	RTDs	Thermocouples	See Page
	2383A	2393A	
2180A Thermometer	1	-	444
2190A Thermometer	-	1	444
2300A Scanner	1	1	450
Option -006	1	1	451
Option -003*	1	-	451
Option -002*	-	1	451
2030A Printer	1	1	455
Y7203 Cable	1	1	448
Y2024 Power Cord	1	1	448

**Ten channels per option. One additional option may be installed in the 2300A. Up to 3 additional options may be plugged into each additional 2301A Scanner Extender. Maximum number of channels is 100.*

Specifications

Please refer to the pages listed above for the specifications and performance characteristics of the instruments and options comprising each system.

Ordering Information

Models

2383A RTD Systems w/2030A Printer
2393A T/C System w/2030A Printer

Note: When ordering 2393A state whether for Type 1, 2, or 3 thermocouple linearizations. See page 447.

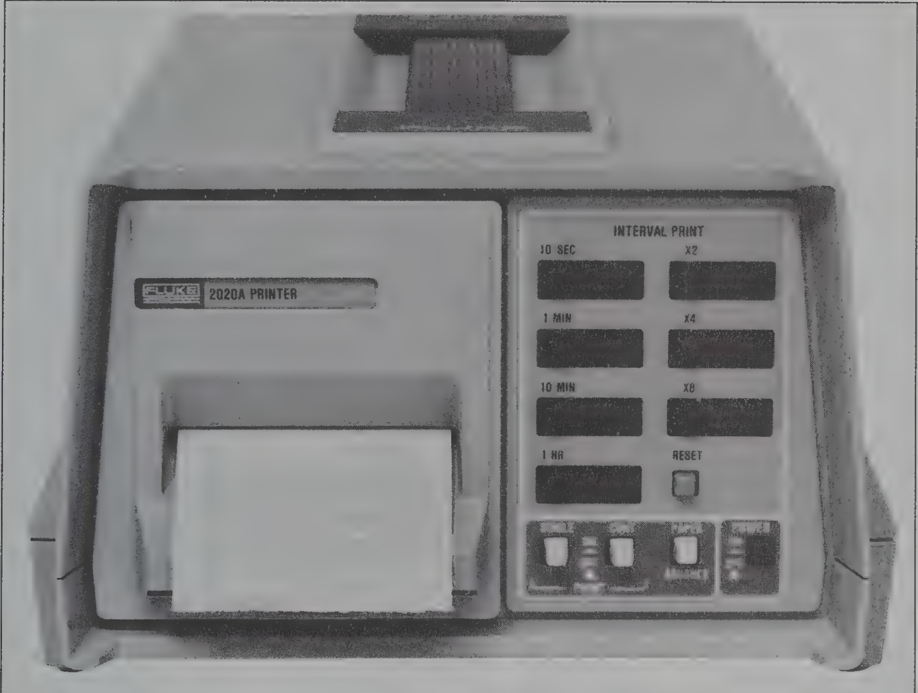
Note: When using the limits function it should be applied at a single channel.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

2020A (TemPak Series)

GPIB IEEE-488

RS-232



2020A with Option -006

2020A Universal Printer

- 20-column thermal printer for recording data from a variety of instruments
- 3 interface options are available: RS-232-C, GPIB/IEEE-488, or Fluke PTI Polling
- Designed to be integrated with a wide variety of Fluke instruments and accessories through an integral latching system
- Time interval print capability with the -006 option
- Capable of running off of 12V dc or ac line power
- Single or continuous print cycles can be triggered either from the front panel or using the remote trigger connector on the rear of the instrument
- Graphic plotting available when using the -003 interface (IEEE-488)

Both the 2020A and 2030A Printers have 20-column thermal print heads for recording measurement data from a variety of Fluke instruments. Especially recommended are those instruments packaged in Fluke's Portable Test Instrument (PTI) cases. They will stack and latch to a 2020A or 2030A Printer and to one another. Connecting cables attach to the rear panels.

Because the 2300A Scanner is designed to let you measure the temperature of numerous points with just one Fluke 2180A or 2190A Thermometer, the 2020A and 2030A Printers are particularly recommended for temperature scanning and logging. Thermometer, scanner, and printer are stacked and latched together and used as an integrated temperature measuring system.

2020A Universal Printer

The Fluke 2020A is a 20 column thermal printer with three interchangeable data interface options. Whether you need GPIB/IEEE-488*, RS-232-C, or Fluke's own Portable Test Instrument (PTI) polling interface, the 2020A has the option to match. The 2020A operates from either the ac power line or a nominal 12-volt dc source.

Graphic Printing

The 2020A with and IEEE-488 interface is capable of printing a dotted graph of incoming data. The data source must send the correct 8-bit binary code for trace-on, 0-99 for the dot location, line feed, and finally trace-off. Use this feature to plot trends and trace profiles in addition to normal print out.

PTI Polling

The 2020A's PTI polling interface contains a microcomputer with addressing intelligence designed to generate the assigned addresses of several instruments in the PTI family. Select a print mode and the 2020A automatically begins polling by sequentially sending addresses one through nine until a measurement instrument recognizes its address. The 2020A then prints both the address and the instrument's current reading. A typical polling system might include the 2020A with a 2190A Thermometer and a 8920A Voltmeter.

Time Interval Printing

Fluke offers the 2020A with time interval printing (Option -006). It allows printing at preselected time intervals from ten seconds up to eight hours. When you use the time interval print option and a PTI polling interface, the 2020A will automatically label the printer tape with elapsed time each time it prints a set of readings.

Your choice of three field-installable interface circuit cards.

Option-002	Option-003	Option-004
RS-232-C	GPIB IEEE-488	Parallel ASCII and PTI Polling
25-Pin Female	24-Pin Female	36-Pin male
Y1707 or Y1708	Y8021 Y8022 or Y8023 Cable	Y7203 Y7204 or Y2036 Cable
	Inst. & Opt. 1722A 1752A 1953A-15 2200B-37 2240C-15 8500A-05 8502A-05 8505A-05 8506A-05 8520A 8840A-05 8842A-05 8860A-05	Inst. & Opt. 2180A-002 2190A-002 2300A-005 2300A-006 7220A-521 7250A-521 7260A-521 7261A-521 8600A-521 8810A-521 8920A-521 8921A-521 8922A-521

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

2020A (TemPak Series)

Specifications

Option Specifications

RS-232-C Interface (-002)

Input Connector: Standard 25-pin, female
Signals: Transmitted Data, Clear to Send, Data Set Ready, Signal Ground, Received Line Signal Detector
Baud Rates: Switch-selectable for 110, 150, 300, 600, or 1200
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,s,μ,z
Buffer Storage: 32 characters

IEEE-488 Interface (-003)

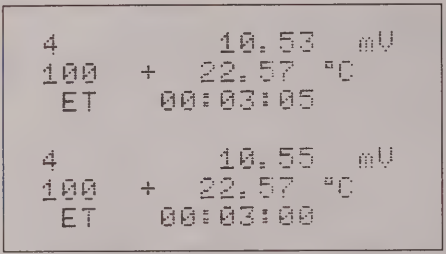
Input Connector: Standard 24-pin, female
Signals: Per IEEE Std 488-1978
Modes: Listen only or Addressable Listen, Switch-selectable
Repertoire: AH1,L1
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,μ,z
Graphic Printing: Dotted trace activated by receipt of the following binary-coded decimal numbers on incoming data lines: in-trace—16, dot location — 0 through 99, line feed—254, out-trace—255.
Buffer Storage: 1 line of data

PTI Polling Interface (-004)

Multi-Instrument Scanning: Up to nine Fluke measurement instruments with each having an internal preset address as follows: Adr 1 — 2180A, 2190A, 2300A; Adr 2—7250A, 7260A, 7261A; Adr3—7220
Input Connector: 36-pin AMP CHAMP, male
Signals: Data, 8 lines, Address, 4 lines; Address Valid; Data Valid; Data Acknowledge; Scan in Progress
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,s,μ,z
Buffer storage: 1 line of data

Time Interval Print (-006)

Print Intervals: Choice of 10, 20, 40, or 80 seconds, 1, 2, 4, 8, 10, 20, 40, or 80 minutes, or 1, 2, 4 or 8 hours
Time Annotation: Elapsed time printed with each reading (if Option -004 also installed)
Clock: Internal, crystal-controlled



```
 4          10.53   mV
100   +    22.57   °C
  ET     00:03:05

 4          10.55   mV
100   +    22.57   °C
  ET     00:03:00
```

Sample section of printed tape showing two readings 5 seconds apart. Reading from bottom to top: Elapsed time (ET) is 00 hours, 03 minutes, and 00 seconds. Address 1 Channel 00 is for the thermometer and address 4 is for the voltmeter.

General Specifications

Type: Thermal, 20-column
Characters: 5 x 7 dot matrix
Print Rate: 3 lines per second maximum
Spacing: 6 lines per inch (2.4 per cm)
Paper: 2.5 in (6.3 cm) wide, 240-ft roll (74m)
Advance: Stepping motor, belt drive
Remote Operation: Rear input, by external contact closure, TTL/DTL compatible
Safety: IEC 348, Protection Class 1
Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤95% to 25°C; ≤75% to 40°C; ≤45% to 50°C
Power: 11 to 15V dc, 90 to 132V ac, or 180 to 250Vac, switch-selectable, 47 to 440 Hz, 40W maximum
Size: Style D PTI Case—13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in x 8.05 in x 12.85 in)
Weight: Approximately 9 lb with paper
Included: Instruction manual, power cord, one roll of paper

Ordering Information

Model

January 1989 prices

2020A Printer	$895

Each printer requires one interface option and can only use one at a time.

Options (for 2020A)

-002	RS-232-C Interface	360
-003	Interface for IEEE-488	345
-004*	PTI Polling Interface	360
-006	Time Interval Print	235

All options field-installable. Cables not included.
**Accepts Y7203 or Y7204*

Accessories (Also see page 485)

Y2016	7" Rack Mount Kit PTI Single	$95
Y2017	7" Rack Mount Kit PTI Double	95
Y2021	5.70: DIN Panel Mount Kit PTI	95
Y2026B	RS232-C Cable Adapter	180
Y2035	Thermal Paper, 10 rolls	68
Y2036*	PTI Polling Cable	83
Y7203	2-ft Cable, 36-Pin, PTI	55
Y7204	5-ft Cable, 36-Pin, PTI	70
Y8021	1m Cable for IEEE-488 bus	130
Y8022	2m Cable for IEEE-488 bus	145
Y8023	4m Cable for IEEE-488 bus	155

**Uses when 2 or 3 PTI instruments are to be simultaneously connected to 2020A via Option -004. Use two cables for 4 or 5 instruments.*

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Comparison of 2020A and 2030A Printers

Features	2020A	2030A
Printers		
Measured data	Yes	Yes
Computed data	No	Yes
Data source identification	Yes	Yes
Real time	No	Yes
Elapsed time	Opt-006	Yes
Engineering units	No	Yes
Header	No	Yes
Strip chart graph	*	Yes
Print Cycle		
Front panel trigger	Yes	Yes
Remote trigger	Yes	Yes
Front panel continuous	Yes	Yes
Remote continuous	Yes	Yes
Pre-selected intervals	Opt-006	Yes
When limits crossed	No	Yes
Intervals and crossings	No	Yes
Computed Data		
mx+b scaling	No	Yes
± difference (delta)	No	Yes
±% (% delta)	No	Yes
Interfaces		
Fluke PTI	Opt-004	Yes
RS-232-C	Opt-002	No
IEEE-488	Opt-003	No

**Using Option -003 and 1722A Instruments Controller or similar computer.*

2030A (TemPak Series)

2030A

2030A Computing Printer

- 20-column thermal printer for recording data from a variety of instruments
- Multi-instruments scanning (up to 9)
- Time annotation - real, elapsed, interval
- Engineering units annotation - up to 4 alphanumeric characters
- Seven print modes
- Runs off 12V dc or ac line power
- Trace mode allows for plotting of data
- Designed to be integrated with a wide variety of instruments and accessories through an integral latching system
- Math mode allows you to program delta, %delta, and mx+b scaling
- Checks for both high and low alarms

The 2030A is a 20-column thermal printer with computing power. It combines standard printing-performance with a multitude of other special features. It is capable of mathematically scaling data and automatically documenting the printed results. It can translate numeric data into a visual trace, and it can apply limits and activate alarms. The 2030A prints data in any one of seven modes—from a single reading to programmed printing at periodic intervals.

Seven Print Modes

Trace: Data graphically plotted between programmable limits
Interval Trace: Graphic trace of data plotted at programmed time intervals
Interval: Prints at programmed intervals
Interval Limit: Prints at programmed intervals and monitors for alarms when not printing
Single: Prints one reading when pushbutton is pushed
Continuous: Continuously prints up to three readings per second
Remote: Prints continuously when activated (via rear panel)

Time Interval Printing

Inside the 2030A is a precision crystal measuring time and allowing you to control when data is scanned and /or printed. A 99-hour clock is set from the front-panel keyboard; elapsed time starts automatically when the power is turned on. The 2030A automatically annotates the tape with the selected time whenever it prints data.

Multi-instrument Scanning

The 2030A's microcomputer contains addressing intelligence designed to generate the assigned addresses of Fluke PTI family instruments. Select a print mode and the 2030A automatically begins scanning by sequentially sending addresses on through nine until a measurement instrument recognizes its address. The 2030A then prints both the address and the instrument's current reading, and polls the next instrument having a higher address. A typical printing system might include the 2030A with a 2190A Thermometer and an 8920A Voltmeter. One or more Y2036 PTI Polling Cables are needed for connecting more than one instrument in parallel to the 2030A.

Math Power

Simply enter two 6-digit constants from the front panel and the printer can calculate the difference (delta) or percent difference (%delta) between a preselected reference value and the input data. You can also program the 2030A to scale the incoming data using the general formula mx+b.

Graphic Printing

Select the range of data you want to analyze and the 2030A will plot a dotted graph over a 2 inch full scale band of tape. Simply program the right and left limits of the graph area as if they were 0% and 100%. Whether the measurement range is "0 to 1000" or "500 to 510" the 2030A automatically expands or contracts the range to fit within the 2 inch scale, and dot by dot plots a graph of the data you're recording.

Alarms

To control and monitor processes, the 2030A gives you the ability to continuously compare the reading of a measuring instrument against two programmable limits with six-digit resolution. If the reading exceeds either the high or the low limit, the 2030A prints the reading, the time, and activates an alarm output.

When the 2030A is in its trace mode, the edge of the graph also act as alarm set points.

2030A (TemPak Series)

Engineering Units

The 2030A can be programmed to annotate data with the engineering units you choose. It overrides the basic measuring instrument's units with four alphanumeric symbols. Use this feature for math scaling and offset to put converted data in the proper units, or to indicate % when printing percent or difference (%delta).

Mode and Function Identification

Each print mode and special function has a distinct label. At the beginning of each print cycle, the 2030A automatically prints the appropriate labels so you know just what operations are to be performed. In the "interval limit" mode, for example, the 2030A prints Hi and Lo followed by the values assigned to each limit.

All labels include real time or elapsed time when in use, instrument address, and a 6-digit header (HD) to indicate the month, day and year or other meaningful documentation. The diversity of symbols and special diagnostic messages add up to data that's easy to interpret today or weeks from now.

Specifications

Technical Specifications

Printer Type: Thermal, 20-column
Characters: 5 x 7 dot matrix
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,s,µ,z
Print Rate: One line for each linefeed command, 3 lines/second max
Spacing: 6 lines per inch (approximately 2.4 lines per cm)
Paper: 2.5 inches wide, 240-foot roll.
Paper Advance: Stepping motor, belt drive
Buffer Storage: 1 line of data
Dacimal Point: Automatically printed in correct location
Print Head Test: Test pattern printed in all columns if paper advance depressed within 1 second of power turn on
Print Modes: SINGLE, CONTINUOUS, INTERVAL, INTERVAL LIMIT, TRACE, INTERVAL TRACE, and REMOTE (operated by contact closure, TTL- or DTL-compatible)
Programmable Units: Up to four characters programmed from front panel. Code set is 64 upper case ASCII characters plus °,f,k,m,p,Ω, s,µ and z. Overrides incoming units.
Programmable Parameters: TIme, Interval, Header, A constant, B constant, Hi Lin, Lo Lim, Units, Spec Adr. All are programmed from front panel.
Clock: Internal crystal. Will measure time intervals and either elapsed time or real-time. Resolution is one second; range is 99 hours, 59 minutes, and 59 seconds. Four modes: Elapsed time only, real-time only, elapsed time and time interval, or real-time and time interval. Real-time runs continuously and elapsed time is reset at the start of each print cycle.
Alarm: Two 6-digit setpoints, assignable, corresponding to six least significant digits of any one measurement instrument. Output is open collector, 28V max. Sinks 30 mA max.
Graphic Printing: Trace is programmed by proper selection of A and B constants. Operates on one instrument. Graph scale is 2-1/8 inches (100 dots) wide. Ten percent scale markers printed. Accuracy ±2% of graph scale.
Math: Programmable to do scaling, delta, and % delta computations by proper selection of A and B constants. Operates on one instrument. Six-digit printout, maximum. Accuracy dependent on scale selected.
Compatible Instruments & Options: 2180A-002, 2190A-002, 2300A-006, 7220A-521, 7250A-521, 7260A-521, 7261A-521, 8920A-521, 8921A-521, 8922A-521
PTI Polling: Prints sequential readings from up to nine Fluke measurement instruments with each having an internal preset address as follows: Adr 1 — 2180A, 2190A, 2300A; Adr 2 — 7250A, 7260A, 7261A; Adr 3 — 7220A; Adr 4 — 8920A, 8921A, 8922A; Adr 6 — 2180A, 2190A, 2300A; Adr 7,8, and 9 — Indirect Addresses. When a thermometer accessory is attached to the 2180A or 2190A via the thermometer accessory connector, the combination of thermometer and accessory acts as one instrument when polled.
Thermometer Interface: Plug compatible with 2180A/2190A with 21X0A-002 output option installed
Scanner Interface: Plug compatible with 2300A Scanner. The 2180A or 2190A Thermometer attached to the 2300A Scanner does not require a 21X0A-002 output option.
Interface: Through 36-pin AMP CHAMP, male connector. Signals: Data, 8 lines; Address, 4 lines; Address Valid; Data Valid; Data Acknowledge; Scan in Progress.

General Specifications

Safety: IEC 348 Protective, Class 1
Temperature: 0°C to +50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤95%, 0°C to 25°C; ≤75% to 40°C; ≤45% to 50°C
Power: 11 to 15V dc, 90 to 132V ac, or 180 to 250V ac, 47 to 440Hz, 40 VA maximum
Size: PTI style D case — 13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in x 8.05 in x 12.85 in)
Weight: Approximately 9 lb with paper
Included: Manual, power cord, one roll of paper

Ordering Information

Model	January 1989 prices
2030A Printer w/Fluke PTI Interface	$1450

Interconnecting cables not included. Order Y7203 or Y7204

Accessories (Also see page 485)

Y2016 7" Rack Adapter, Single	95
Y2017 7" Rack Adapter, Double	95
Y2021 Panel Mounting Kit	95
Y2035 Thermal Paper, box of 10 rolls	68
Y2036* PTI Polling Cable	83
Y7203 2 ft Cable, 36 pin PTI	55
Y7204 5 ft Cable, 36 pin PTI	70

** Required when 2 or 3 measurement instruments are simultaneously connected to 2030A. Use two cables for 4 or 5 instruments.*

Service & Support

Warranty

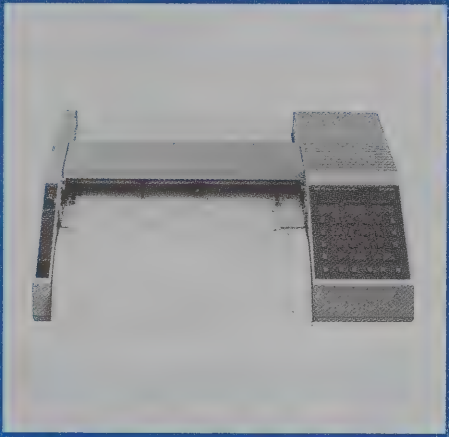
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

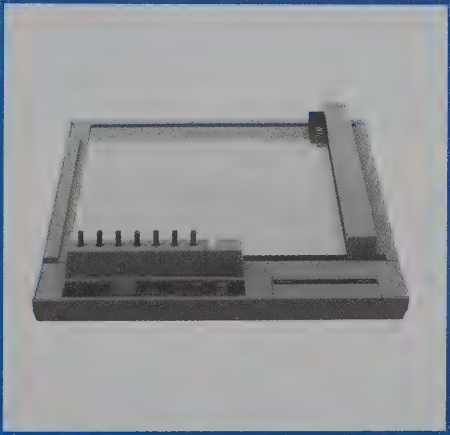
SC1-2030A Repair (w/calibration)	113

Recorders & Plotters

Page 458 PM 8238



Page 462 PM 8272



Page 464 PM 8155

The simplest and quickest method of measuring and permanently registering a low frequency signal is with an analog recorder. Fluke and Philips provide a choice of XY recording (signal vs. signal) and line recording (signal vs. time) combined in the versatile PM 8271 single pen and PM 8272 two pen recorders, covering many measurement applications.

In system applications and for hard copy of digital oscilloscope displays, the PM 8155 digital plotter excels. With both HPGL and Philips GL as standard, GPIB/IEEE-488 or RS-232 interfaces, and a large 32K byte input buffer, plotting of measured data is both fast and simple. For repeated plot applications, an automatic feeder is available.

For measurement and recording of up to 30 voltage or temperature inputs, the PM 8238 multipoint recorder offers the combined advantages of traditional graphic recording as well as numerical recording. With its reliable thermal print system, the PM 8238 is ideal for long term recording of tests and monitoring applications.

Multipoint Data Recorders 458

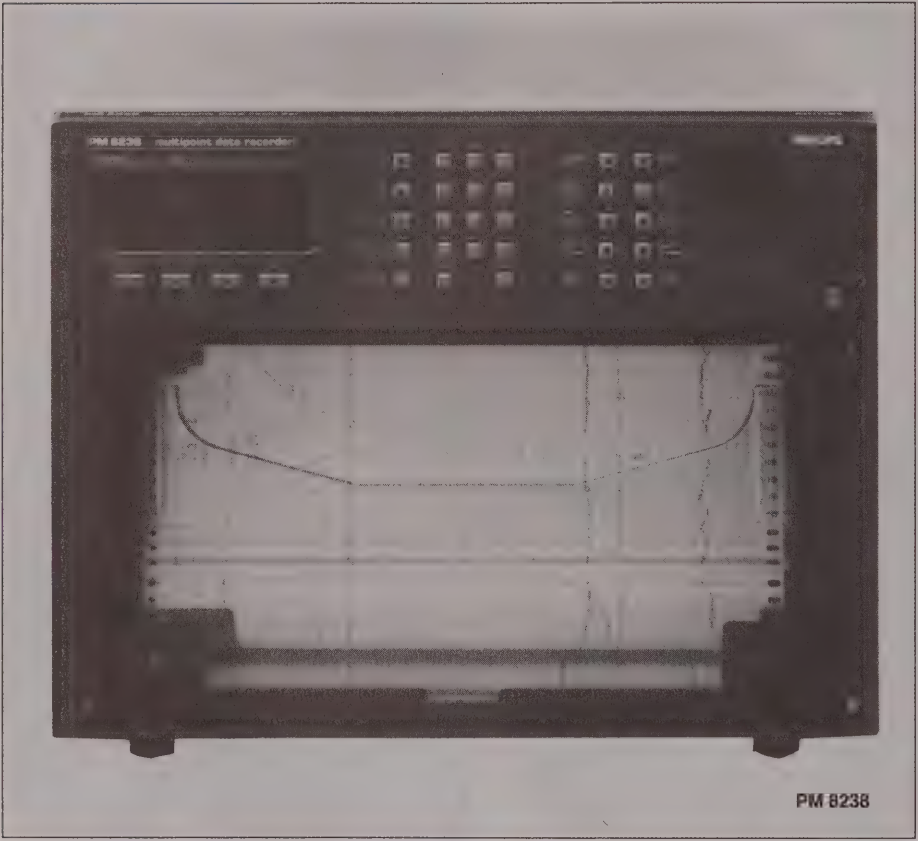
Universal Recorders 462

Digital Pen Plotters 464

PM 8238

GPIB IEEE-488

NEW



PM 8238 Multipoint Data Recorder

- Maximum 30 input channels, scanned at 10/s
- Graphic or numeric data presentation
- Optional alarm output plug-in cards
- Interpolation between measuring points for continuous line-plots
- Memory modules for user-program storage
- AX + B scaled measurements
- Maintenance free thermal printing

The PM 8238 is a 30 channel data recorder of the highest quality and reliability and is specifically designed to be set and left running for extended unattended operation. It offers real measurement versatility with features such as memory modules, which allow storage of settings. It can directly record voltage or temperature, with a wide choice of sensors in 2- or 4-wire configurations. Scanning takes only 100 ms/channel, for quick alarm detection. Individual measurement values are presented on a front-panel display: chart output can be numeric for clear presentation of values; graphic, for spotting trends; or both in combination.

Dependable Plotting, Durable Construction

The PM 8238 has been designed and constructed to give the highest quality and reliability in operation. Very reliable low noise reed relays are used for channel switching. The relays are tested to three times the normal operating life of the instrument. The number of components and PCBs is less than in similar instruments and the wiring has been reduced, cutting the chance of instrument failure; and special attention has been given to a rugged, durable construction. Quality and reliability is such that a high MTBF has been achieved.

Printing is by a high quality, maintenance free thermal print head. The user does not have to change pens, replace ribbons, fill ink reservoirs or clear inkjets. The head is virtually unaffected by dusty environments, ensuring sharp, quality plots throughout the life of the instrument.

To match the quality and reliability, the PM 8238 offers high accuracy and has a very broad spectrum of functions.

Systems Use

This instrument is ideally suited for unattended, preprogrammed operation, where the reliability is of maximum benefit. With optional IEC-625/IEEE-488 (GPIB) or V24/RS 232-C interfaces, operation in a computer controlled environment is possible. These allow various functions such as output of measured values to a computer/controller, remote control and set-up, presetting and programming and synchronized measurements. An optional extended TTL-control interface card provides remote control of some other functions such as chart speed, scan start, channel changing and printing event markers, all via TTL level signals. At any time, a complete survey of parameters can be requested.

Comprehensive Presentation Capabilities

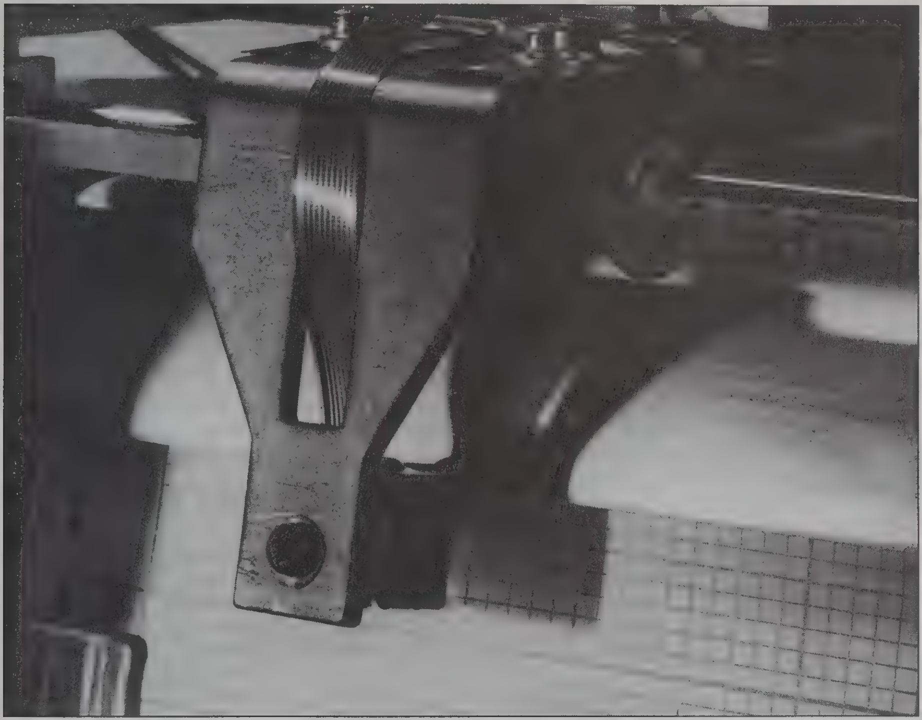
The full scale definition of 1000 dots represents a resolution of 1 µV over the 250 mm (10 in.) plot width (at 1 mV span). Each channel is stamped with its number and the plots are date and time stamped if required, allowing easy archiving and copying of plots for distribution. Measurement speed is such that all 30 channels are scanned in 3s; this makes the PM 8238 ideal for real-time monitoring and control of many variables; it also provides for quick reactions to alarms. Because of the high speed, it can also be used for monitoring cause and effect on adjacent channels and for most applications, the plotting on such channels may be regarded as simultaneous. Charts are plotted on standard z-fold 250 mm (10 in.) wide thermal paper.

The AX + B scaling function allows display of the appropriate range for the variable: for example when operated with a humidity sensor, instead of displaying the mV output, that channel can be scaled to read from 0...100%.

In standby mode, input from the front panel or from a controller in a system set-up is directly recorded on the chart. Other information recorded on the chart includes chart speed; temperature at the isothermal input block for cold junction compensation; alarm points; functional units - V, °C or scaled; and the time of unexpected events such as power interruption. Dot density is alterable for each channel if the operator wishes one to be highlighted.

Numeric or Graphic Mode

Numeric mode directly outputs the values of individual measurements, in a 10-column tabular form, and this mode can be instantly selected at any time while recording. It can also



print out automatically, at user defined intervals of one minute from 1 to 99, allowing quick overviews of actual measurement results. Printouts include codes to show fault conditions such as out-of-scale, under-scale, thermocouple break or alarm conditions met.

Graphic mode gives optimum interpretation of results. It has a switchable interpolation mode that fills in dots between the actual measurement points. This gives continuous line plotting for direct detection of trends, peaks and irregularities. The fast measurement time (100 ms/channel) ensures the user can interpret events virtually in real-time. Comprehensive zero suppression facilities permit a flexible choice of scale positioning, so together with a chart speed continuously variable over 60 mm/min to 60 mm/h, optimum use is made of printout area. Multiple readings in the same range can be re-scaled for immediate comparisons. Direct plots can also be automatically made of the difference in measurements on different channels, speeding up comparisons and eliminating the potential for calculation error. A numeric print out can be selected automatically, while in graphic mode, at user defined intervals in steps of 10 minutes.

Simple Yet Versatile Operation

No previous knowledge of the instrument, or knowledge of software or programming are needed to operate this instrument. All tasks such as linearization and mixing of variable measurements on different channels are automatically handled by the recorder. PM 8238 can handle any combination of voltage or 2- or 4-wire temperature measurement on the maximum 30 channels (15 for 4-wire operation). Parameter settings are entered directly at the instrument keyboard, or from a remote PC or controller via one of the systems interfaces. All function keys have an LED to indicate activation. Keyboard settings are lockable to prevent accidental changes.

Programming is simple, via front panel keystrokes and clear error messages are provided. The range of possibilities for unattended operation is extended by the programming modules which can store settings. There is even a "copy channel" function for fast repeat programming.

Voltage Measurements

Choice of voltage ranges up to a maximum of ±30 V, with spans of 1 mV to 30V. The zero suppression facility allows the span to be located as a window over the selected range, and is entered by typing in the zero- and full-scale values of the window.

Temperature Measurement

Pt 100 uses the 4-wire connection, eliminating errors due to wire resistance; and the low 0.77 mA source current prevents self-heating.

For thermocouples three different forms of cold junction compensation are provided:

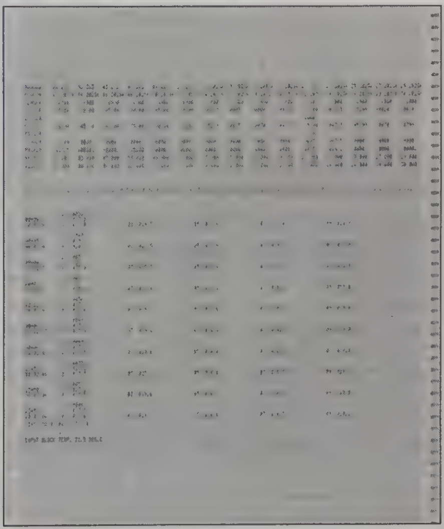
- automatic
- fixed at 0°C, 20°C or 50°C
- compensation from any other channel, eliminating the need for long compensation wires if the instrument is not near the measurement point.

Cold junction compensation is achieved by a built-in isothermal block ensuring <$^{1}/_{4}$°C difference between terminals. The block is in a lockable compartment at the back, to protect it from any external effects such as direct heat radiation or convection. The difference measurement facility also helps eliminate cold junction errors; it automatically calculates the difference in readings beeen two channels, greatly reducing this type of inaccuracy (common to two channels).

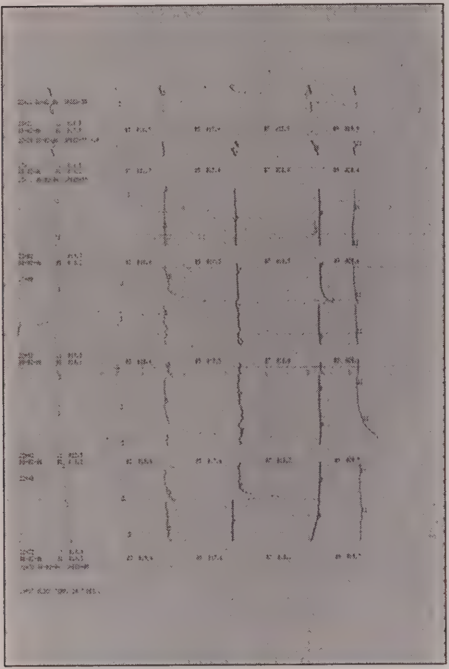
Linearization is automatic for the 4 most common thermocouples: J-, K-, S- and T-type, with options for R-, B-, E-type, Nicrosil/Nisel and Ni-Ni. The zero suppression facilities described in the voltage measurement section are also available for temperature measurement. Error messages alert the operator if something goes wrong such as a break in thermocouple connection.

Alarms

The alarms may initiate one of several responses: e.g. increasing line intensity, print only on alarm or vary the chart speed. The PM 8328 unit provides for a maximum of two alarm cards to provide several alarm combinations. Slot 1 provides one minimum alarm and one maximum for odd numbered channels; slot 2 the same for even numbers. The cards simply plug-in and two common contacts for min/max values are provided.



PM 8238



Specifications

Technical Specifications

Voltage Measurements

Ranges and Spans:

Function	Permitted span	Full- and zero-scale limits	Range
mV	1...30 mV	-30...+30mV	30 mV
	5...300 mV	-300...-30 mV +30...+300 mV	300 mV
	50...3000 mV	-3000...-300 mV +300...+3000 mV	3000 mV
V	0.5...30 V	-30...+30 V	30 V

Accuracy: ±0.1% of input value ±0.1% of span
Temp. Coefficient of Accuracy: 0.2% of the input value per °C

Input:
Input Offset Voltage: <5 µV (= 1.25 mm at span of 1 mV)
Input Offset Voltage Drift: <0.5 µV/°C
Input Current: <100 pA
Input Impedance: 10 MΩ
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Possible Input Configurations: 2- and 4-terminal
Common Mode Rejection Ration (CMRR): >132 dB for DC
Series Mode Rejection Ration (SMRR): >38 dB for 50 and 60 Hz ± 1%
Measurement Time: 100 ms per channel

Thermocouple Measurements

Thermocouple Types:
J-type (Fe-Const)[1]
L-type (Fe-Const DIN)
K-type (Chromel-Alumel[1] + DIN)
S-type (Pt-Rh 10Pt[1] + DIN)
T-type (Cu-Const[1])
U-type (Cu-Const DIN)

[1] *IEC 584-1, IPTS 68*

Ranges and Spans

Type	Permitted span	Full- and zero-scale limits °C (see note)	Range
J, L	25...700 250...850	-200(-50)...+500 -100(-20)...+705	500 750
K	30...900 300...1470	-200(-50)...+700 -100(-20)...+1370	700 1370
S	250...1600	0...+1600	1600
T, U	35...600	-200(-50)...+400	0400

Note: The minimum input temperature above which full resolution (100 points) is obtained at the minimum span is indicated between brackets.

Accuracy (excl. Thermocouple): basic accuracy ± cold junction contribution ±0.1% of span

Basic Accuracy (over rated temp. range):

Type	Range	Basic Accuracy
J, L	500°C	±0.1%, T_{in} ±0.2°C (±0.55°C, T_{in} <50°C)
	750°C	±0.1%, T_{in} ±0.3°C (±0.4°C, T_{in} <-20°C)
K	700°C	±0.05%, T_{in} ±0.35°C (±0.75°C, T_{in} <-50°C)
	1370°C	±0.1%, T_{in} ±0.7°C (±0.8°C, T_{in} <-20°C)
S	1600°C	0.1% T_{in} ±1.3°C
T, U	400°C	±0.1%, T_{in} ±0.3°C (±0.6°C, T_{in} <-50°C)

Cold Junction Contribution: ≈ 1.2 x cold junction

Cold Junction Accuracy:
Measured Internally (Automatic): ±0.45°C ± 0.02(T_{amb} - 23)°C
Measured Externally (in Channel NN): Accuracy of external channel NN
Fixed (at 0°C, 20°C or 50°C): accuracy of external supplied temperature
Input Configurations: 2- and 4-terminal
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Measurement Time: 100 ms per channel

PT 100 Measurements

Pt 100 Temperature Measurement Current: 0.7685 mA
Span: 25...1050°C (span is the difference between the selected full-scale value FSV and the selected zero-scale value ZSV)
Full- and Zero-scale Limits: -200...+850°C
Accuracy (excl. Transducer): ±0.10% of T_{in} ± 0.25°C ± 0.06(T_{amb} - 23)°C ± 0.1% of span
Linearization: Acc. to DIN 43760/BS 1904: 1964
Input Configuration: 4-terminal input
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Measurement Time: 100 ms per channel

Resistance Measurements

Transducer Resistance: 0...3.9kΩ
Measuring Current: 0.7685 mA
Accuracy of the Current: ±0.015%
Temperature Coefficient of Current Source: 0.005% per °C
Input Configuration: 4-terminal

Differential Measurements
A channel X can be programmed to measure the difference relative to another channel Y

Alarm Relay (in PM 8238 and PM 9895)

Contact Ratings:
Switched Power: 10 W max.
Switched Voltage: 45 V_{DC} or 30 V_{AC} max.
Maximum Voltage between Contacts and Earth: 42 V_{DC} or 30 V_{AC} (rms)
Alarm to Contact Closure Time: depends on number of measured channels
Current through Closed Contacts: 2 A, DC or AC (rms) max.
Contact Resistance: 50 mΩ

General Specifications

Mains Voltage (Factory Set): 220...240 V_{AC} ± 10%; 110...127 V_{AC} ± 10%
Mains Frequency: 50 Hz ± 5% (can be set to 60 Hz)
Electrical Safety: Acc. to IEC 348 class 1; VDE 411 class 1
Dimensions (h x w x d): 284 x 352 x 444 mm (incl. feet)
Weight: Approx. 13 kg.
Climatic Conditions: Acc. to IEC 359, C1 tested acc. to IEC 68
Rated Temperature Range: operation within spec, +5...+50°C; limits of operation, 10...+50°C
Humidity: 20...80% RH non-condensing
Max. Dewpoint Temp: 26°C
Storage and Transport: Acc. to IEC 359; temperature -40...+70°C
Reference Conditions: Acc. to IEC 359; temperature 23°C ± 2°C; humidity 45...75% RH
Warm-up Time: 30 Minutes

Resolution:
Recording in Dot Mode: 0.1% of span (1000 points)
Recording in Numeric Mode: absolute value of the measured input with signal printed to four digits
Displayed Value: absolute value of the measured input with signal indicated to four digits.

PM 8238

Included with the instrument:
- package of 5 books of folded thermo-sensitive paper (20 m each), black imaging
- 2 fuses 1.6 A-T
- mains cord
- paper output tray
- program module
- operating manual "PM 8238 Multipoint Data Recorder"
- operating manual "PM 8238 Interfaces to other devices"

KS 8238 Industrialized Configuration

This multipoint recorder comes in two mainframe versions. The PM 8238 is designed for laboratory/bench top environments while the KS 8238 is designed for more industrial/systems environments. Both mainframe versions use the same internal hardware and software components. They differ only in packaging. The KS 8238 comes with all of the hardware necessary to panel mount standard. It also has a locking, gasketed front panel that covers the entire front of the instrument. This makes it more impervious to dusty and dirty environments as well as providing additional security against operator error. The KS 8238 also does not have a main power switch to make it easier to slave it off of the system power.

Ordering Information

Model

January 1989 prices

PM 8238/013 30 Channel Multipoint Recorder	$5500
KS 8238/013 30 Channel Multipoint Industrial Configuration Recorder	5950

Accessories

PM 9141/02 3 Program Modules	$175
PM 9838/20 19 inch Rackmount Unit	140
PM 9890/02 RS 232C/V24 Interface	800
PM 9891/02 IEC-625 Interface	950
PM 9893/01 Extended Control Interface	350
PM 9895/02 Alarm Relay Card for 15 channels	525
PM 9930A/03 5 books Z fold Paper, length 20m	90

Additional Thermocouple Linearization Units

PM 9897/03 Type R (0...1765C)	450
PM 9897/13 Type B (250...1820C)	450
PM 9897/23 Type E (-200...400C)	450
PM 9897/33 Type E (-100...1000C)	450
PM 9897/43 NiCrSi/NiSi (0...800C)	450
PM 9897/53 NiCrSi/NiSi (0...1200C)	450
PM 9897/63 Ni/Ni, 18% Mo (0...1400C)	450

Cables

Y1707 2m Cable for RS 232C	125
Y1705 RS 232C Null Modem Cable	75
Y8022 2m Cable for IEEE-488	145

Service & Support

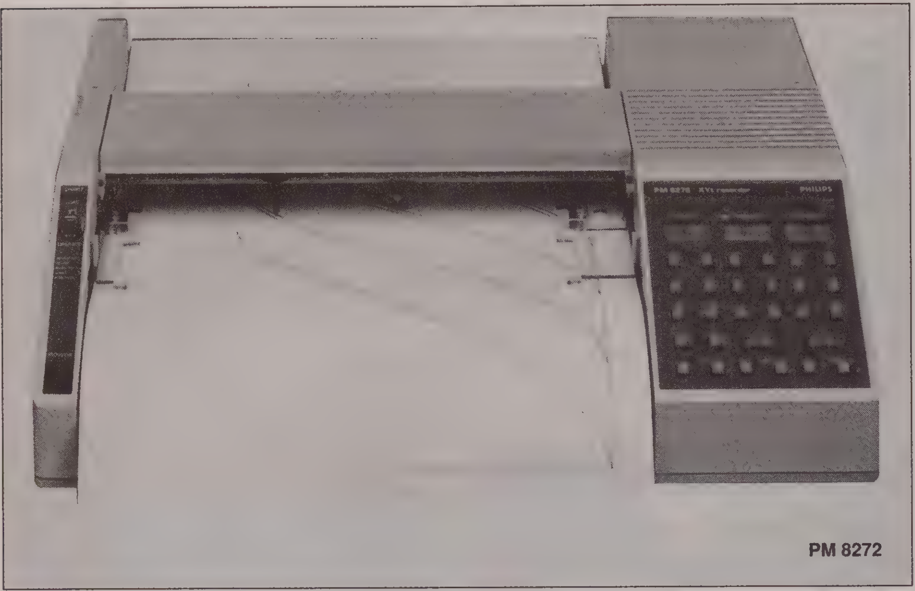
Warranty

One and a half year warranty. (See page 470 for further information on warranty terms and conditions).

Note: The above configurations meet North American requirements. For other power options see page 491.

PM 8271 & PM 8272

GPIB IEEE-488



PM 8272

PM 8271/PM 8272 Universal Recorders

- XY and Xt (line) recording, single or dual pen
- A3, A4, A and B size sheet or Z-fold paper
- High slew rate to record fast signals
- 24 timebase settings/chart speeds (including 10 user programmable)
- 40 µV/cm to 2 V/cm sensitivity (1 mV to 50 V full scale)
- Auto-zero suppression
- Optional rackmount kit available

The PM 8271 single pen and the PM 8272 dual pen recorders offer precision XY and line recording in the same instrument, with many functions built-in for both modes. Now you can have top quality XY and Xt recording without having to specify two instruments. They can be used with sheet paper up to ISO A3 (297 x 216 mm)/ANSI B (11 x 17 in.) size, or with Z-fold paper for charts or multiple X-Y recordings.

Most XY recorders hold the paper stationary on a flatbed writing surface, and then move the pen in X and Y axis. The PM 8271/72, however, moves the paper in one axis, and the pen is then moved in a perpendicular axis. The result is superior versatility for both XY and Xt recording.

The PM 8271/72 range of standard functions includes automatic paper edge detection and sheet positioning for A3, A4, A and B size paper for simplified X-Y recording. When Z-fold paper is used, these recorders offer a large flat-bed area for convenient note-taking. Throughput is very high as there is no need to wait for electrostatic chart holds to release (as on standard flatbed XY recorders). Other problems related to electrostatic chart holds such as paper bubbling and susceptibility to dust are also eliminated.

X-Y Recording

For recording one measurement parameter versus a second (generally not time), the PM 8171 provides a reliable, accurate paper transport, high sensitivity input, timebase and remote control interface.

The PM 8272 expands on this performance, with dual pan performance to record two parameters versus a third.

Line Recording

As line recorders, for recording one or two parameters versus time, the PM 8271/72 have high input sensitivity and exceptional long-term stability, making them ideal for product endurance tests requiring consistent, precision recording over extended periods.

They have a unique auto zero-suppression mode, which ensures fast connection to unknown signals by automatically setting a calibrated offset. This facility will read just the zero-suppression if the measured signal moves off-scale. With this feature it is possible to make unattended high resolution measurements without the risk of losing important information through off-scale pen movements.

The PM 8271/72 have low-cost temperature inputs covering PT100, J-type and K-type thermocouples. These simply plug into the rear panel of the recorder, and provide full linearization and cold junction compensation.

Optional accessories such as event markers and rack mounts, plus wide-range mains and DC power supplies further increase the versatility of these instruments.

Keyboard Operation

A keyboard with full LCD indication for each channel setting has replaced the conventional rotary switches, making all recording functions instantly accessible. To ensure that important tests cannot be disturbed by unauthorized personnel, a keyboard disable function can be used to prevent keyboard access.

Enhanced Recording Features

The PM 8271/72 feature a variety of improved performance features. A diagonal speed of more than 130 cm/s for sheets in the X-Y mode ensures accurate tracking of incoming signals.

Recording versatility is enhanced through a selection of 25 measurement ranges for both the X (chart) and Y (pen) channels. These range from 40 µV/cm to 2V/cm, equating to full scale inputs from 1 mV to 50V. This large range often eliminates the need to use uncalibrated measurements for signals just above the range limits.

For the chart channel, user-programmable chart speeds or time-base settings allow custom settings to meet the needs of specific applications. Chart speeds can be set as required in the ranges 30 to 1200 mm/min. and 10 to 1200 mm/h.

Where measurement signals with DC offset are to be recorded, PM 8271/72 have 7 calibrated zero-suppression levels covering signal offsets of up to 500%. With this high performance level, special care has been taken to avoid measurement errors caused by noise and spurious signals, resulting in a CMRR of 150 dB for these recorders.

Bench, Rack or Field Operation

The PM 8271/72 will operate on a wide-range of power supplies. The high efficiency switched-mode power supply can be used on power voltages of 115V or 230V (+/-15%) without switching. A separate 24 VDC input is also provided as standard for convenient field operation.

The recorders are compact, making them ideal for bench use, while the optional slide-in rackmount allows them to be built quickly and easily into larger measuring systems housed in 19-inch rack units.

PM 8271 & PM 8272

Logic, RS 232 or GPIB Interfaces

The PM 8271/72 have a standard logic-level external control input for system measurements which allows basic functions like penlift, servokill, dipmarking and chart speed to be controlled. Alternatively, bus-controlled operation, via the RS 232/V24 and GPIB interfaces, enable functions like range and zero-suppression to be controlled. This makes these recorders suitable for integration into complete system measuring applications.

Advanced Mechanics and Materials

The use of high-density, engineering-grade polycarbonate casings provides outstanding mechanical properties in terms of rigidity, dimensional stability and durability, as well as giving an attractive appearance. A special injection molding technique results in extremely fine mechanical tolerance, so that each part fits exactly.

This construction technique ensures a high degree of functional integrity, as well as consistent high quality in manufacture through elimination of traditional assembly procedures involving numerous individual components.

MTBF of over 20,000 Hours

These two recorders use the latest, thoroughly proven technologies in both electronics and mechanical construction, ensuring an outstanding specification and full conformity with all applicable safety regulations.

The 8271/72 are manufactured in Philips' new instrument factory, using high quality components and advanced manufacturing processes (NEN 2646 approved). Application of stringent quality-assurance standards is an essential and integral part of the overall manufacturing process. With this advanced technology in design and manufacture, it has been possible to achieve an MTBF figure of more than 20,000 hours for these recorders.

Specifications

Technical Specifications

Types: PM 8271 single pen and 8272 dual pen
Modes: XY and Xt (line) recording

Media Sizes

For XY Modes: For XY or line modes Z-fold sprocket paper, 20m long (PM 9920 types)
ISO A4: 210 mm x 297 mm (8.27 in x 11.68 in)
ISO A3: 297 mm x 420 mm (11.69 in x 16.54 in)
ANSI A: 279 mm x 216 mm (11 in x 8.5 in)
ANSI B: 432 mm x 279 mm (17 in x 11 in)
Maximum Writing Area (XY mode): 250 mm x 380 mm (9.84 in x 15 in)
Variable Sensitivity Adjustment: By potentiometer from calibrated span (0.5 to 1.0 times span)
Accuracy: <0.25% fsd
Dead Band: <0.2% fsd
Linearity: 0.1% fsd
Calibrated Zero Suppression: 0%, 50%, 100%, 150%, 200%, 300%, 400%, 500% of range
Variable Zero Suppression, for both Chart and Pen Channels: By potentiometer from -5% to +105% of range
Input Impedance: 1 MΩ
Input Type: Floating
DC CMRR for Chart and Pen Channels: >150 dB
AC CMRR (<100 kHz): >130 dB
AC CMMR (50/60 Hz): >56 dB
Maximum Input Voltage: 30 VDC: range <500 mV fsd; 42 VDC: range >500 mV fsd
Timebase/Chart Speeds: 14 fixed speeds of 10, 20, 30, 60, 120, 300, 600 and 1200 mm/h; and 30, 60, 120, 300, 600 and 1200 mm/min. plus 10 user definable speeds
Power: AC: 115 or 230V 15%, 50 to 60 Hz (no switching required)
Dimensions: 132 mm H x 444 mm L x 345 mm W (5.2 in H x 17.4 in L x 13.5 in W)
Weight: 5 kg (11 lb)
Safety Approvals: IEC 348 class 1
Environment Approvals: IEC 359 class 1 (C1, M1, S2)
Operating Conditions: +5 to 40°C, 20 to 80% RH
Storage Conditions: -40 to +70°C, 5 to 95% RH
EMI: VDE 0871 B, VFG 1046
Warm-Up Time: <30 minutes

Chart/Y Channel

Calibrated Input Sensitivity: 25 calibrated ranges from 40 µV/cm to 2 V/cm in a 1:2:4:5:8: sequence
Writing Speed: Sheet paper 90 cm/s; Z-fold 30 cm/s
Step Response Time: Sheet paper 0.9s; Z-fold 0.28s (over 250 mm)

Pen/X Channel

Calibrated Input Sensitivity: 25 calibrated ranges from 40 µV/cm to 2 V/cm in a 1:2:4:5:8 sequence (Equivalent to 1 mV to 50V fsd)
Writing Speed: 100 cm/s
Step Response Time: 0.25s
Penlift: Front panel or remote control
Supplied with the Instrument: Two pens per channel, 50 sheets A3 paper, one packet Z-fold paper, fuses, operating manual, cleaning brush, potentiometer oil, screwdriver, sheet paper guide, dust cover, AC power cable, DC power cable, remote control DIN connectors.

Ordering Information

Models

January 1989 prices

PM 8271/01 Single Pen XY/Line Recorder	$1850
PM 8272/01 Dual Pen XY/Line Recorder	2650

Accessories

PM 9870/10* Left Hand Event Marker (only available as factory-fitted option)	175
PM 9870/20 19-inch Rackmount Kit 3E high	on req
PM 9870/30 Sliding Rackmount Kit	175
PM 9870/40 Dust Cover (not for use with PM 9870/30)	125
PM 9191/02* GPIB Interface	350
PM 9190/01* RS 232 Interface	350
PM 9877/01 Pt 100 Unit	200
PM 9877K/2 K Type Thermocouple Unit	200
PM 9877J/2 J Type Thermocouple Unit	200

** Must be factory installed. Please state these options clearly when ordering.*

Consumables

PM 9856/05 10 Blue Pens for PM 8272 (lower channel)	50
PM 9857/05 10 Red Pens for PM 8271 or PM 8272 (lower channel)	50
PM 9857B/05 10 Blue Pens for PM 8271 or PM 8272 (upper channel)	50
PM 9920/00 0 - 10 mm Linear ScaleZ-fold Paper with 10 mm grid (20m)	35
PM 9920/01 100 - 0 Linear Scale Z-fold Paper with 20 mm grid (20m)	35
PM 9920/05 0 -10 mm Linear Scale Z-fold Paper with 20 mm grid (20m)	35
PM 9953/53 Pack of 250 Sheets ANSI B Paper	35
PM 9953/54 Pack of 500 Sheets ANSI A Paper	35

Use of stated paper and pens is recommended for optimum drawing quality. Pen life: if kept covered when not in use, pens will draw lines approximately 1500m long.

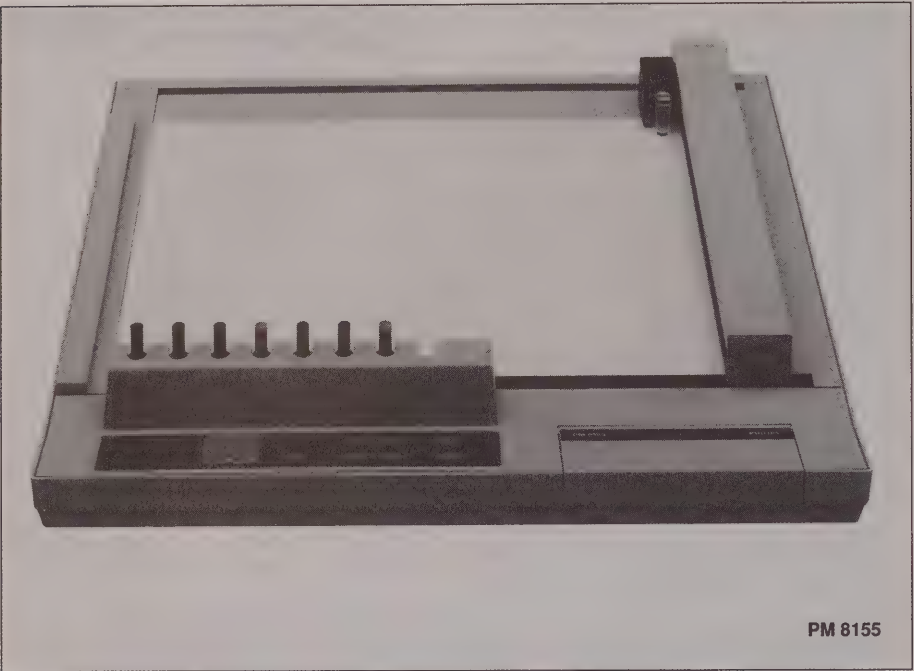
Service & Support

Warranty

One-year product warranty. See Page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. for other power options, see page 491.

PM 8155



PM 8155

PM 8155 Digital Pen Plotter

50 cm/s pen speed, 0.05 mm resolution
Accepts multiple media up to 11 x 17 inch (287 x 410 mm)
Auto-Sheet feeder
Full 32k Byte Buffer
HP-GL™ and Philips-GL compatible, either RS-232C or GPIB/IEEE-488
8 Pens/Colors, Automatically Selected

The PM 8155 multicolor plotter meets your hard copy graphics needs with an outstanding combination of performance, versatility and ease-of-use. Compatible with a wide variety of Fluke and Philips instruments, it provides a strong complement to your test systems-as well as supporting your computer-generated graphics needs.

Fast, Precise Performance

This multi-purpose plotter produces easy-to-read graphics in up to 8 colors (all automatically selected) on a variety of media including both paper and transparency, in 11 x 17 inch (ISO A3) and 8-1/2 x 11 inch (ISO A4) sizes.

Resolution of 0.05mm, with reproduceability of 0.1 mm (0.3 mm with pen change) ensures precise, clean graphics. The maximum plot speed of 50 cm/s, regardless of pen direction, provides timely results. Plot speed is also fully programmable in 1 cm/s increments to further ensure superior trace quality.

Expanded Buffer for Improved Efficiency

With a full 32k Byke input buffer, the PM 8155 ensures user-efficiency by being able to accept a large volume of input data. This frees the source instrument (oscilloscope, etc.) or computer from which it is plotting to move on to the next task while the plotter is at work.

Convenient Auto-Sheet Feeder

Efficiency of use is further enhanced by the optional sheet feeder. Accommodating 8-1/2 x 11 inch (alternately ISO A4) sized sheets, the feeder includes a paper cassette and an output stacking tray. Both can easily be added to the plotter with no need for adjustment or modification, making the PM 8155 ideal for unattended production of large series of multiple plots.

Versatile Graphics Language and Interface Options

Built-in intelligence/firmware provides compatibility with both HP Graphics Language (HP-GL™) and Philips-Graphics Language, with simple rear panel selection. Further, both GPIB/IEEE-488* and RS-232C models are available, assuring compatibility with a wide variety of application needs.

The versatile PM 8155 can also be used as a straight-forward printer, printing out all data as received, including control characters and delimiters. This allows incoming data to be analyzed, providing information about the computer or instrument/plotter combination.

Added Fluke & Philips Compatibility

The PM 8155 is ideal as an output device for a variety of other Fluke and Philips instruments. Interface it directly to the PM 3350 or PM 3320A digital storage oscilloscopes, for example, with the need for a controller, to provide high resolution, hard copy documentation of both the signal and the scale factors displayed on the CRT. Add the Auto-Sheet feeder, and the DSO's Auto-Plot feature lets you document long series of single-shot events-unattended.

Specifications

Media Sizes: ANSI-A: 8 1/2 x 11 in; ISO A4 (210 x 297 mm). ANSI-B: 11 x 17 in; ISO A3 (297 x 410 mm)
Maximum Plotting Area: 11.3 x 16 1 in (297 x 410 mm)
Paper Hold: Electrostatic
Pens: 8 (or 7 + digitizing reticle); [7 (or 6 + digitizing reticle) when paper feed used]
Pen Type: Fibertip, transparent, permanent, liquid ink drafting
Media: Paper, transparency
Resolution (min. addressable step size): 0.05 mm; 0.025 mm internally
Reproduceability: 0.1 mm; 0.3 mm (after pen change)
Pen Velocity (max axial): 50 cm/s, programmable from 1-50 c/ms, in 1 cm/s steps
Pen Acceleration: Max 0.3g with pen down
Interfaces: IEEE-488; implemented functions SH1, AH1, T6, L3, SR1, RL0, PP1, DC 1, DT0, C0, E1. RS-232C; Terminal wiring, full duplex, protective ground, baud rates 300-9600
Input Buffer: 32k Byte
HP-GL Character Fonts: US ASCII, French, German, Swedish, Norwegian, English, Italian, Spanish, Portuguese, Katakana. Additional user-defined characters
HP-GL Compatibility: PM 8153, HP 7475
Philips GL Character Fonts: US ASCII, French, German, Spanish, Swedish
Philips GL Printing Styles: Matrix, Simplex, Mulitiplex

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 8155

Philips GL Compatitibilty: PM 8151, PM 8153, PM 8154, 297 mm sizes, capacity 100 sheets, comprising paper cassette and stacking tray
Automatic Paper Transport: Optional sheet feeders for 8-1/2 x 11 in or 210 x 297 mm sizes, capacity 100 sheets, comprising paper cassette and stacking tray
Power Supply: 115 or 230V ±15%, 50-60Hz
Temperature Range: 5 to 40°C (operating); -27 to 70°C (storage)
Size: 170 H x 555 W x 483 D mm
Weight: 11.2 kg net, (30.02 lbs); 13.5 kg (39.19 lbs) with paper feed unit
Included: User Manual, Protective Cover, Fibertip Pens (red, blue green, black) 2 each, Digitizing Reticle, Pad of 11 x 17 in (287 x 410) mm) paper (50 sheets), Fuses, Power Cord, Soft Plastic Dust Cover
Power Comsumption: 45 VA

Ordering Information

Models

January 1989 prices

PM 8155B/13 Plotter w/IEEE-488 Interface	$1750
PM 8155S/13 Plotter w/RS-232C Interface	1750

Options

PM 9855/01 Sheet Feeder, 210 x 297mm (ISO-A4) Paper Format	500
PM 9855/51 Sheet Feeder, 8-1/2 x 11 in (ANSI-A) Paper Format	500

Accessories

PM9955/01 Set of 2 x 4 fibertip pens; red blue, black, green	$45
PM 9955/05 Set of 2 x 4 fibertip pens; purple, yellow, violet, brown	45
PM 9876S/901 Set of 10 overhead pens, 5 colors	70
PM 9953/53 Pack of 11 x 17 in (ANSI-B) Paper, (250 sheets)	35
PM 9953/54 Pack of 8-1/2 x 11 in (ANSI-A) Paper, (500 sheets)	35
PM 9953/03 Pack of 287 x 410mm (ISO-A3) Paper (250 sheets)	on req
PM 9953/04 Pack of 210 x 297mm (ISO-A4) Paper (250 sheets)	on req

Customer Support Services

Customer Support

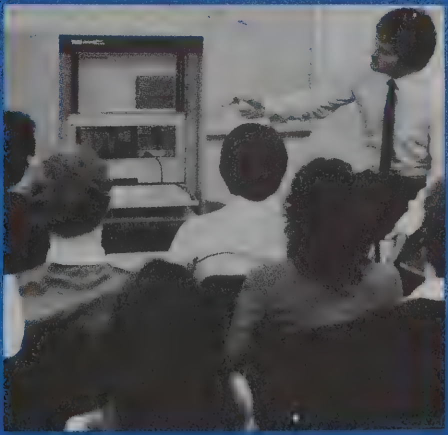
Repair, calibration and system integration

As our customers demand new and more complete test and measurement solutions, Fluke and Philips are becoming more than a manufacturer of affordable, efficient products. We are dedicated to providing the best services possible to support our products in your specific application. To protect your product investment, Fluke and Philips Technical Service Centers are located worldwide to support you with parts, repair and calibration services.

To ensure you realize maximum productivity in your specific application, Fluke and Philips also offer applications and maintenance training, software and systems integration services, and product application consulting.

Extend the quality of your instruments with our Customer Support Services. You can expect responsive service and support that's right for your specific needs.

Training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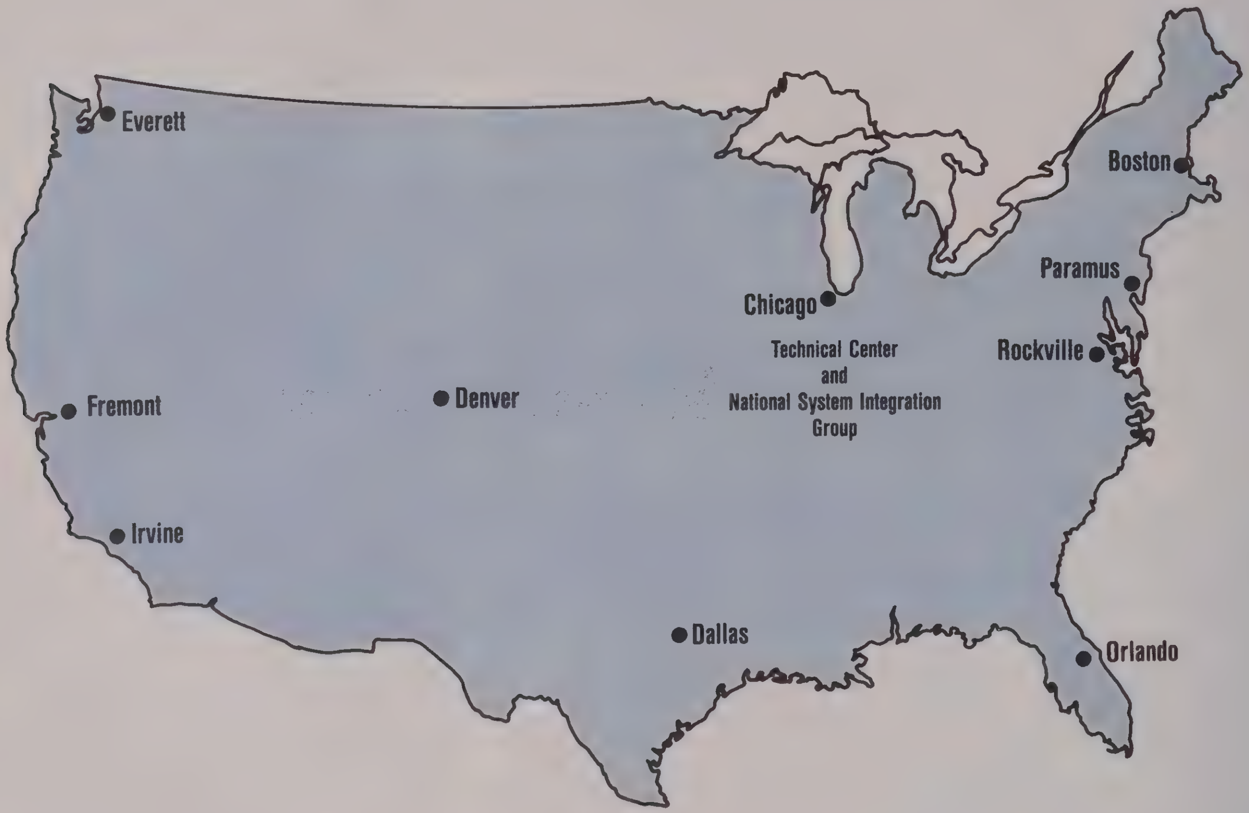
World-wide Technical Service Centers



See page 493 for listing.

Corporate Headquarters

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Service Offerings

Services	Advantages	Option 1	Option 2	Option 3	Option 4
		Performance Verification	Calibration	Complete Repair	Full Service: Calibration & Complete Repair
NEW Full Coverage Service Agreement • OEM	Discount per instrument mix, dollar volume and length of contract	•	•	•	•
Extended Warranty	10% Discount plus significant savings over standard prices (all CRT's are included)	•	•	•	•
Blanket Purchase Order	10% Discount (standard prices)	•	•	•	•
Standard Price Service - Emergency 48 Hour	Savings over Labor & Materials Costs - Special Service	•	•	•	•
Labor & Materials	Out of production/ modified instruments		•	•	•
Service Methods Fluke Technical Center		•	•	•	•
Pick-up & Delivery (selected areas)		•	•	•	•
On-Site		•		•*	

• Indicates availability of service option
**On selected instruments*
Special discount promotions throughout the year.
Discounts cannot be combined with other discounts.

Value-added Services	**Costs**
• 90 Day "Full Instrument" Warranty, including CRT (Storage CRT's included only if replaced)	No Charge
• Service Reports	No Charge
• Calibration Certification & Instrument Labels	No Charge
Options	
• Automatic Upgrades	Call Technical Center
• In and Out Calibration Reports	$15 to $75 depending on instrument type
• MIL-STD 45662 Calibrations	"

Self-Maintenance

- Service Parts
- Modular Exchange Program (MEC)
- Recommended Spare Parts Kits (RSPK)
- Upgrade/Service Kits
- Operator and Service Manuals
- Provisioning
- Microfiche Program Includes:
  - Product Change Notices
  - Parts
  - RSPK
  - MEC
  - Manual Index
  - Technical Bulletins/Troubleshooting Information

Metrology Services

- State-of-the-art, primary standards lab
- NIST (NBS) traceability
- Cost-effective, convenient service programs:
  - Traceability Maintenance Programs
  - Standards Calibration Services
  - Support for "1990 Electrical Unit Change"

Calibration & Repair

Calibration and Repair Services

- Variety of services to meet each customer's needs
- 90-day warranty of complete unit
- Installation of product improvements
- Full NIST (NBS) traceable calibration and/or alignment
- Documented quality assurance program
- Compliance with MIL-STD-45662 and nuclear industry standards
- Special calibration data available
- Pick up and delivery services

Each Fluke Technical Center is equipped with the necessary instruments, standards, procedures, and personnel to maintain Fluke and Philips products at peak performance. The procedures and documentation comply with MIL-STD-45662 and Nuclear Regulatory Commission requirements, assuring accuracy traceable to the National Institute of Science & Technology (National Bureau of Standards). Proper use of measurement standards is carefully and continually monitored through a corporate Controlled Audit Program.

Fluke's Customer Support Services is dedicated to a single goal — providing the best possible service for both our products and our customers. To achieve this goal, we have expanded our range of repair and calibration services to provide more solutions and flexibility for our customers.

Every service is designed to meet a different level of product support, whether it's a single unscheduled repair or a five-year Service Agreement that meets MIL-STD-45662.

Service Warranty

Fluke warrants products it services and parts it sells to be free from defects in material and workmanship for the period given below:

(1) product repaired under Standard Price Program for 90 days from shipment of repaired product.

(2) product repaired under Extended Warranty Plan for the period of the extended warranty.

(3) product repaired under Labor and Materials Services for 90 days from installation, replacement parts installed under OnSite Repair Program for 90 days, and labor under OnSite Program for 14 days.

(4) service parts for 90 days from date of shipment.

This warranty applies if you are the original purchaser. It does not apply to fuses, disposable batteries, or any product or part which has been misused, altered or damaged by accident or abnormal conditions of operation.

For warranty service, contact your nearest Fluke Technical Center for shipping instructions. If the product is returned to the Technical Center, it should be shipped freight prepaid.

Fluke will, at its option, repair your product or provide a module exchange free of charge. However, if Fluke determines that the failure was caused by misuse, alteration, accident or abnormal conditions of operation, you will be billed for the repair. After repair, we will return the product, freight prepaid.

THE WARRANTY STATED ABOVE IS YOUR SOLE AND EXCLUSIVE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OR MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.

NEW Full Coverage Service Agreements

- Comprehensive coverage for Fluke, Philips and for mixed instrument types
- Flexible Service Agreements that meet your total installed test and measurement instrument needs
- Most cost-effective service
- Large volume and multi-year discounts
- Handle all your service needs with one simple plan

The traditional high quality service you expect on your Fluke and Philips instrumentation is now available on your other test and measurement equipment. Call us to tailor a Full Coverage Service Agreement for your workload and reduce your costs, with Fluke quality!

You can reduce your costs substantially with Service Agreements. But you'll save more than money — you'll also save paperwork and administration time. An Agreement is based on the total cost of your yearly services.

It's as easy as this. Contact your local Fluke Sales Representative or your nearest Technical Center Manager and discuss your product mix and yearly requirements. We will develop a quotation for a Service Agreement for your review and consideration. We can even customize a plan that precisely fits your needs.

The dollar volume can include any mix of products on any service plan. You cannot, however, combine Extended Warranty discounts with Service Agreement discounts.

The manager of your nearest Technical Center will determine the mix of Fluke services that gives you the greatest discount. Call today and learn exactly how much you can save this year.

O.E.M. Services

If you are an O.E.M. customer for Fluke and Philips products, we also have repair and calibration services to meet your needs. Because your business needs require special support, we suggest you contact your local Fluke Sales Representative. Once we know your needs, we can tailor a service plan that supports your business.

Extended Warranty Service

- Fixed maintenance cost so you can budget accurately each year
- Prioritized service
- Shorter repair cycle
- Reduced parts inventory
- Lower maintenance training costs
- Less demand on your technical personnel and resources
- All parts are covered, including CRTs

Fluke and Philips' Extended Warranty Plan provides your equipment the ultimate protection at one economical price. Comprehensive agreements provide routine calibration at regular intervals or repair service as needed. Or, you can combine these options for full service coverage.

NEW Extended Warranty Performance Verification Plan

This plan is the same as Calibration except that only those specific values found to be beyond 70% of their rated accuracy specification will be adjusted. We verify your instrument according to detailed performance procedures. The instrument will be given a verification label and you will be notified of any out of tolerance conditions for traceability. This plan saves you money over calibration, plus gives you faster turnaround time. This is available on-site as well.

Extended Warranty Calibration Plan

Trust the scheduled calibration of your Fluke instruments to the world's leading manufacturer of calibration instrumentation and standards. Under this plan, we'll calibrate your instruments at the Fluke and Philips recommended intervals. In accordance with our extensive calibration procedures. You'll automatically receive a 30-day advance notice that your instrument is due for calibration. If your instrument's application requires a different calibration interval than normally recommended, we can tailor a plan to meet your needs. Either way, you can expect priority service and turnaround.

We'll return the instrument with a Certificate of Calibration for your records. Should you need more documentation to meet MIL-Standards we can easily include detailed Calibration Reports as part of this plan for a nominal charge.

Extended Warranty Complete Repair Plan

This plan is an extension to your product's warranty. Whenever your product needs repair service, simply send it to the nearest Fluke and Philips Technical Center. There, it is repaired, recalibrated, and performance tested — with priority scheduling. All parts and labor are included in the price of this service, even parts that are normally excluded from the Standard Price Service plan. So there won't be any surprises, even return surface freight costs are included. As you might expect, a Fluke Service Report and Certificate of Calibration is enclosed with each repaired instrument. Contact the nearest Fluke and Philips Technical Center for complete terms of the extended warranty.

Extended Warranty Full Service Plan

If you need both scheduled calibration and periodic repair service, there is no better maintenance program for your Fluke and Philips equipment than our full service plan. We've combined all the features of the Extended Warranty Calibration and Extended Warranty Complete Repair into one full service plan at a discount. You pay a reasonable fee for each instrument, eliminating most additional service expenses.

Plan Ahead and Save

We offer a 10% discount on the listed price of all extended warranty plans when you purchase the agreement at the time of instrument purchase. Even if you purchase this service prior to the expiration of the product warranty, we'll discount your plan by 10%.

You can also reduce your maintenance expenses with a Service Agreement. This agreement is based on the total dollar amount of your Extended Warranty or other service plans.

Pre-plan Inspections

Sometimes an instrument inspection is required before we can offer an Extended Warranty plan. This usually occurs when an instrument's warranty has expired. An inspection at a Fluke Technical Center is free or you can pay a minimal fee for an inspection at your site. If the condition of your instrument precludes coverage, we'll provide a Labor and Materials Service quote for the repairs necessary to qualify your instrument.

Blanket Purchase Order

- Reduced paper work
- Less administrative time
- Discounts

Open a purchase order with Fluke, thus making your calibration and repair work easy, but still on a per-incident basis and we will give you a 10% discount off the standard price.

Standard Price Service

- One-time repair or calibration at a fixed price
- Added support for your own maintenance program
- Take advantage of Fluke and Philips' expertise and resources on an as-needed basis

These cost-effective services can be used to repair or calibrate your Fluke and Philips equipment on a one-time basis. For customers who routinely service their own instruments, this service offers an easy way to smooth out your peak workloads. For others, it's an easy and economical way to take advantage of Fluke's extensive service.

The Standard Price Service Program establishes a fixed charge for calibration and/or repair for each type of instrument. The price for calibration and/or repair includes labor and most material required. Exception parts are noted in the price list.

These standard prices, which are based on historical averages for time and material, help you determine service costs in advance and avoid the potentially critical delay of quotation approval procedures. Naturally, some units may have to be excluded from the program because of age or abuse. In such cases you will be advised and, if you approve, charged on the basis of the actual labor and parts required.

NEW Standard Price Performance Verification

Same as the Extended Warranty Performance Verification, but for one time, non-agreement service, based on a fixed, budgetable price.

Standard Price Calibration

Routine calibration ensures your product is performing to published specification. Every instrument calibration follows the procedures specified in our maintenance manuals. Instruments are then returned with a Fluke Certificate of Calibration, your proof of traceability to the National Bureau of Standards. In addition, we also include calibration labels to indicate the date of calibration and the date of next calibration, as well as tamper-proof seals to protect the integrity of the calibration performed.

Standard Price Full Service

This is a cost-effective way to service your Fluke and Philips product on a one-time basis. Using the industry's finest test equipment, our factory-trained technicians will test all functions and ranges while making the required repairs. We replace any defective parts with Fluke and Philips specified and tested parts to ensure the repaired instrument performs to manufacturer's published specifications.

During repair, we will also install product changes that enhance the instrument performance and reliability. Then, it is calibrated in the same mannner as in the Standard Price Optimized Calibration service, complete with the same certification, labels and seals. Each unit is completely performance tested and returned with a service report.

Calibration & Repair

Warranty

Standard Price repairs carry a complete instrument warranty for 90 days. This warranty covers the entire instrument, not just the portion that was repaired. (Storage CRTs are excluded unless replaced during the repair. All CRTs over 7 years old are also excluded.) This is the best warranty in the industry.

A Fluke Calibration Warranty guarantees your instrument's calibration for 90 days after it's returned to you. Even if the product fails, you pay only the repair charge and recalibration is provided at no charge.

NEW Emergency 48-Hour Service

When an instrument fails and downtime is costing you hundreds of thousands of dollars, use our emergency 48-hour service. From the time your instrument arrives at a Fluke Technical Center to the moment we ship it back to you, it receives first-priority access to parts, labor and equipment in the service lab.

This 48-hour service is available for a rush charge of $100 for calibration and, $200 for repair in addition to the standard repair price. (except for Handheld Multimeters and Digital Thermometers: Calibration & Repair for $25). If for any reason we cannot meet the 48-hour commitment, you will be notified immediately and, of course, charged only the standard service fee. Call your nearest Fluke Technical Center for immediate help.

Labor and Materials Service

- Instruments that are out-of-production and no longer included on the standard price list
- Instruments that have been seriously damaged
- Instruments that have been exposed to unusual conditions or harsh environments
- Products that have special modifications
- For any special service requirements.

Sometimes you may want or need a firm price quotation of labor and material repair. Using this service, you'll know exactly the cost to get your instrument repaired. And, to keep you on schedule, this firm quote is valid for 30 days and also includes an estimated turnaround time for repair.

Discontinued Products

We stand behind each Fluke and Philips product for its full life cycle. This means we'll service instruments manufactured more than 20 years ago or even those we discontinued. These repairs, however, are handled case-by-case because of the availability of certain parts.

Pre-plan Qualification

If you would like to take advantage of our Extended Warranty plan, but your instrument does not pass the inspection, you can count on the Labor and Materials plan to get your equipment qualified. We'll always give you an estimate of the necessary repairs, whatever the reason for failure.

Modified Products

If you have a Fluke or Philips modified or special product, it may require an additional charge to qualify for the Standard Price Service or Extended Warranty plan. To find out if this applies to your special equipment, call your Fluke or Philips Technical Center.

Warranty

Instruments repaired under Labor and Materials Service are warranted to be free from defects in material and workmanship for 90 days. This applies to the entire instrument, not just the repaired portion, which is unique in the industry.

Service Methods

- Fluke Technical Center
- Pick up and delivery
- On-site
- International and Philips Service Centers in selected countries

Fluke Technical Center Service

- Quick turnaround
- Local or regional proximity to your business

Instruments are typically portable. So when your instrument requires calibration or repair ship it to us and we will service it and return it. Return shipping is free under service agreements and extended warranty plans.

NEW Pick Up and Delivery Service

- Eliminate your shipping paperwork and costs
- Reduce downtime

If you have many instruments requiring service and are within selected service regions a van can be dispatched to you for this service. Request this time saver today.

On-Site Service

- Performance Verification
- Minimize downtime
- Guaranteed response time
- Preventive maintenance
- Custom agreements
- System Service

Most systems you buy from Fluke include a 90-day on-site warranty. Under this warranty coverage, we'll repair your system on-site in the event it fails. After this 90-day period, each instrument in the system continues to be covered by the Fluke standard warranty. The instrument service would then be performed at one of our Technical Centers.

If you would like to continue on-site service after the 90-day on-site warranty period, you can request a Supplemental On-Site Service Agreement. The instruments that are commonly used in systems can be covered by Supplemental On-Site Service. This eliminates the need to remove the instrument from the system and send it to a Fluke Technical Center for warranty service. The fee is nominal, just the extra expense of on-site service from the Fluke Technical Center to your facility.

After the warranty period and the Supplemental On-Site Service coverage, you can continue on-site service by using our Basic On-Site Service. Also you can now have your instruments verified within an accuracy range or repaired when necessary on-site, with our On-Site Performance Verification offering.

International and Philips Service Centers

- Worldwide support
- Multinational corporation assistance

Fluke and it's affiliates are trained and equipped to meet your needs in most countries around the world.

Value-Added Services

- No charge
    - -90 Day "Full Instrument" Warranty, including CRTs
    - -Service Reports
    - -Calibration Certification & Instrument Labels

Not only do you get the best warranty in the industry, but you can also receive free service reports, calibration certificates and labels.

Service Reports

When your instrument is repaired by a Fluke Technical Center you automatically receive a Service Report for any work performed.

Calibration Certificates & Labels

For every product calibrated, Fluke includes a Certificate of Calibration. It's your guarantee that the instrument meets its specifications and is traceable to the NIST (NBS). Any instrument calibrated by a Fluke Technical Center will be returned with a calibration label indicating the date of calibration and the date of next calibration. We'll also affix tamper-resistant seals to your instrument.

Options

- Automatic upgrades
- Calibration documentation
- MIL-STD-45662 service

Automatic Upgrades

When you return your instrument to a Fluke Technical Center, the professional technicians will upgrade your instrument to the latest revision, thus improving your performance.

Calibration Reports

If you need more detailed reports for MIL-STD-45662 or in-house quality assurance programs, we can provide comprehensive calibration reports. This includes the actual readings taken from each range and function of an instrument.

MIL-STD-45662 Calibrations

If you require calibration that meets MIL-STD-45662 we can provide this service and the documentation. Full compliance with 45662 includes the following items:

- Formal calibration procedures with recording of test results before and after any necessary adjustments.
- Records of calibration dates and identification of calibration standards and technicians.
- Records of accuracy of test standard's accuracy and controlled environmental conditions.
- System of notification and recalibration when test standards are found to be out-of-tolerance.

Self-Maintenance Programs

- Several customer-oriented programs for doing your own calibration and repair

Service Parts

- Components that meet Fluke and Philips specifications standards
- Automatic supply of improved replacement types
- 90-day warranty
- Toll free parts order line (800) 526-4731
- Recommended spare parts and module kits

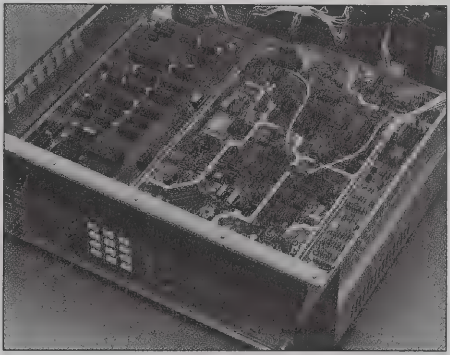
Availability of replacement parts is a key element in providing quick turn-around and product support for customers who perform their own maintenance. By providing quality parts and responsive support, Customer Support Services will help return your Fluke or Philips products to peak performance.

To support this service, an extensive inventory of repair parts is maintained by the Service Parts Center located in Everett, Washington. This computerized center stocks several hundred thousand components, subassemblies, and modules that are listed on a microfiche catalog. All replacement parts are warranted against defects in materials and workmanship for 90 days after shipment. From most U.S. locations, you may place your orders directly to the Service Parts Center by calling our toll-free number, (800) 526-4731. From Alaska, Hawaii, or Washington call (206) 356-5774. You may also order by Telex # 185249 or FAX (206) 356-6331. From locations outside the U.S., place your parts order with your nearest International Representative, who will expedite processing or fill your order from local inventory.

When ordering, please identify parts by the Fluke 6-digit or Philips 12-digit part number and description as shown in the instrument manual and, if possible, by the schematic diagram circuit reference number. The model number and serial number of the instrument will also help us supply the correct parts.

In some cases parts must be ordered in matched sets in order to maintain the specified accuracy and performance of the instrument after repair. Check the parts list and diagrams for footnotes which contain the instructions for ordering special parts.

Recommended Spare Parts Lists and Spare Parts Kits, and instrument manuals are also available for most Fluke or Philips products.



Module Exchange Program

- Available for most modular products
- 48-hour delivery to most U.S. locations
- Minimum downtime for critical applications
- Reduced maintenance personnel training requirements
- Takes full advantage of product diagnostics
- 90-day warranty
- Toll Free Order Line (800) 526-4731 or Telex # 185249, FAX (206) 356-6331

Many Fluke instruments are modular in design and can be serviced most effectively by exchanging a defective module.

The Module Exchange Program allows you to obtain an exchange module quickly and economically. When using this program, you need only identify the defective module, which simplifies your troubleshooting procedures and reduces your training and skill requirements for maintenance personnel. Self-diagnostics built into many Fluke instruments further simplify the process of identifying the faulty module.

Once an out-of-warranty, defective module is identified, you can place your order with the Module Exchange Center located in Everett, Washington by calling our toll free number (800) 526-4731. From Alaska, Hawaii or Washington call (206) 356-5774. The replacement module will be sent directly to you via overnight air carrier. You will also receive return shipping instructions for the defective module, which must be returned to avoid charges. A similar program is offered to customers in countries outside the U.S.

Please contact the Fluke Module Exchange Center or International Representative for a list of Fluke products which are supported by the Module Exchange Program, and detailed information on exchanging defective modules.

Recommended Spare Parts Kits

Based on product lifecycle data, our Service Engineering group has recommended an optimal list of replacement parts required to ensure maximum instrument uptime. These kits are available for most current products. If you have an instrument in a remote location or if maximum uptime is a priority in your specific operation, please call our Service Parts Center for a kit to support your particular model.

NEW Upgrade/Service Kits

You can keep your instruments up-to-date yourself with specially kitted upgrades. These kits both improve performance or increase reliability. Also, a unique **Surface Mount Device Service Kit** is available to repair your state-of-the-art instrumentation. Included with this kit is all the tools and accessories required, as well as a video-based training package. Call the Fluke Service Parts Center in Everett.

Operator and Service Manuals

Documentation is the mainstay of the technician. They are obtainable through the Service Parts Center.

NEW Provisioning

Do you need a full range of provisioning services? Fluke has a service for you that meets your specifications or those of military standards 1552A/1552B today.

NEW Microfiche Program

If you repair or calibrate Fluke instruments and want to take advantage of the latest product improvements, our Product Change Notice Subscription Service on microfiche is for you. This service offers a complete collection of notices describing product changes, reliability improvements, upgrade kits, and safety modifications.

Complete information is provided to allow you to modify and update your instruments. Notices include the reason for the recommended modification, technical instructions, drawings, and parts list.

The base set comes in a binder containing 35 fiche which hold over 2200 Change Notices. More than 350 Fluke products are included — from handheld multimeters to board test systems. An index card, sorted by model number, lists each Change Notice and a brief description of the change. A microfiche reader with a 24X lens is recommended for best viewing.

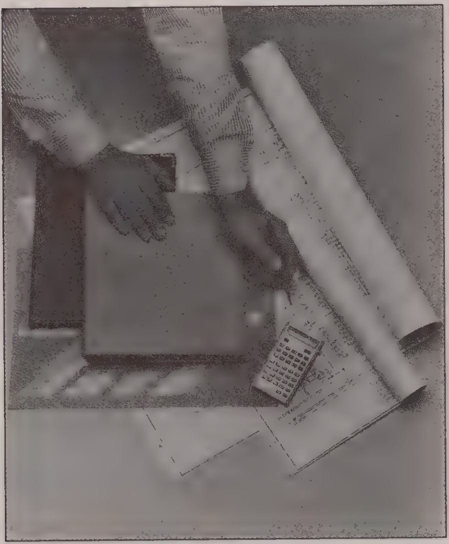
Included free with the base set are Fluke's Service Parts catalog and Customer Support Services literature. Together, this set makes a valuable reference for those who perform in-house maintenance of Fluke equipment.

To keep your base set up to date, order the annual subscription service. New and revised Change Notice fiche are mailed in January, May, and September. You'll receive a renewal notice near the end of the subscription period as a reminder to reorder for the coming year.

Product Change Notice Base Set
Complete collection plus two updates to provide coverage for one year.
Fluke P/N 847777 $295 U.S. List Price

Product Change Notice Subscription
Mailed in January, May, and September.
Fluke P/N 847780 $150 per year

System Integration



Systems Support/Solution

- Measurement & Test System Consulting
- Hardware Configuration
- Software Design and Development
- Project Coordination
- Installation Support
- Authorized Third Party Support through Fluke Cooperative Services
- Turnkey Projects

When Fluke and Philips electronic test and measurement equipment is used in a systems application users often require additional support from Fluke. The Fluke Systems Integration Group provides a wide range of services from consulting and start-up assistance to hardware and on-site software development. We will make sure your project gets on track quickly, and stays on track.

The Fluke Systems Integration Group can provide support tailored expressly for your application. Whether you need complete turnkey solutions or additional manpower to augment your in-house programming staff, Fluke has the solution.

Fluke's Systems Integration Group has a team of designers and Fluke Cooperative Service (FCS) partners ready to assist you with your systems integration needs. When you take advantage of Fluke's expertise you can be confident that your system design will reflect the latest technology configured to match your application.

Our services are designed to support a wide variety of customers from first-time users of Fluke and Philips equipment to customers creating advanced systems on accelerated implementation schedules. When you plan to implement an instrument system, count on our Systems Integration Group and FCS for help. No one knows test and measurement like Fluke and Philips. At Fluke we can custom tailor a solution specifically for your application.

Extensive System Testing

Prior to arrival, Fluke systems are tested for functionality both before and after a system burn-in period of 96 hours. These tests are over and above our extensive, standard tests for the individual system instruments. On arrival, Fluke performs a system installation, verifies system operation and reviews operating procedures with your personnel.

Complete System Service

Confidence in your system extends beyond the value of the system itself. You have system expandability to meet your future needs. In addition to supplying quality hardware and software, Fluke provides training and 90 day on-site service as part of the total package.

Documentation

Our instruments and systems include full documentation. Fluke systems include instrument operator and service manuals, system manuals and drawings. Fluke also makes available other references, including Technical Data Bulletins, applications notes, technical papers and service information.

Ask your Fluke Sales Representative about the many successful system projects.

Fluke Cooperative Services

- Independent specialists
- Specific industry expertise
- Team resources for large projects

Fluke's Cooperative Services program may be the answer to your test, measurement, or control application.

Today's projects require integration of hardware, software, training, and support to arrive at a total solution — on time and within budget. Today's projects call for teamwork. That's why we formed Fluke Cooperative Services (FCS).

The Fluke Cooperative Services team is a network of independent specialists who know hardware, who know software, and who know your industry.

With Fluke and FCS, there's no more shopping around and no more unclear accountability.

We carefully selected FCS members because of their expertise and because they are team players. We've already worked together, so we're ready to go to work for you on your project.

Teamwork and FCS — put them to work for you. You'll have one team to work with and one team that will stand behind its promises. We think that's better than passing the buck.

Fluke will always ascertain whether an FCS partner will ensure a successful solution, especially when your application is in a vertical market that fits the FCS's expertise, and the FCS has the expertise to provide a complete solution.

Software Programming

- Data Acquisition
- Board Test
- Measurement

Fluke will analyze your test, measurement or control requirements. Then we will propose the best approach for you to get your programmable instruments or system operational.

Your solution may be:

- an instrument "programming" training course
- consulting to establish a software design for your software engineers
- a complete turnkey project delivering your software on time and within budget, based on an agreed to system software description and proposal.

Fixturing

- Value-Added Board Test
- Specifications/Recommendations

Fluke has researched and evaluated several third party vendors of test fixtures for ATE and testers like the 9100 Digital Test System, and offer these authorized, independent fixturing/programming houses in the Fluke Cooperative Services (FCS) program.

If you want to extend your automation through fixturing — card edge, bed-of-nails, autoprobing, or custom — you can feel confident the job will be done well with an FCS partner who specializes in your industry.

Installation Services

- Integration/Start Up
- "Getting Started" Support
- On-site training
- On-site service agreements

Installation of your system is performed by a Fluke Service Engineer from the nearest Fluke Technical Center. The Technical Center will call you in advance to discuss site preparation and to schedule the installation.

When your system arrives and the Technical Center has been notified, the Fluke Service Engineer will travel to your installation site for the actual installation. Installation takes typically one day and consists of the following steps:

1. Uncrating the system and checking for any shipping damage.
2. Verifying the contents of the shipment against the packing list.
3. Assembling and powering up the system.
4. Running the Self-Test Software. A Self-Test software procedure is supplied either embedded in the system software or on a separate diskette with the system. This software enables the operator to test each of the instruments in the system through a series of functional evaluations.
5. Familiarizing your personnel with System documentation which includes explaining the purpose of each manual and each floppy disk.

System Integration

6. Familiarizing your personnel with System operation. Formal software training is also available upon request.
7. Performing the customer acceptance sign-off, which means, your representative will sign both the acceptance letter and the Field Service Report.
8. Presenting our Customer Support Package, explaining who to contact for service, service agreements, training and systems assistance.

System Components

- Data Acquisition Multifunction Board for Fluke 1752 or 1711A/AA
- 9000/9100 Series Pod Adapters

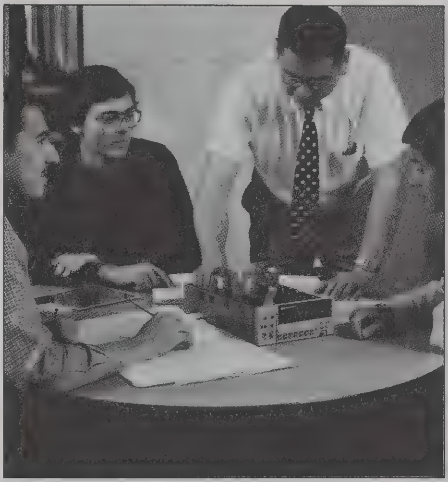
Throughout Fluke's history of creating systems, several product enhancements have been developed. They are available at a reasonable cost to help your systems come together both better and faster.

The multifunction boards' standard features include:

- Multitasking Commands for "stand-alone" processing power, allows the Fluke 1752 or 1711A/AA to concentrate on supervisory tasks, report generation and operator interface.
- 20 kHz Sampling of 8 differential analog inputs to characterize or react to rapid events.
- Store 27,000 Readings so the Multifunction Board can scan at high speed without constant attention of the user program.
- Continuous Control with 4 Analog Output channels, allows you to "close the loop" without adding options.
- 16 Digital Outputs for parallel output, "On-Off" control or device actuation.
- 32 Digital Inputs for status sensing or parallel input.

Inquire of your Fluke Sales Representative about additional features and capabilities.

Microprocessor specific interface pods can be custom built for your unique processor. Even though the 9000/9100 Series have the most extensive pod support in the industry, your microprocessor may not be covered. Several have already been built for the 8097 family, Z8, 6801/AA, 6803, and 3870, all for customers unique circuit boards. If you want a custom pod adapter, call your Fluke Sales Representative and provide us a schematic and working circuit board, for a quote today.



How to get Help

Your Fluke Sales Representative can discuss with you your system requirements. He can put you in contact with an extensive group of specialized sales people who will help you technically define your system requirements. Then a Fluke CSS Project Manager can coordinate a team of Customer Support Engineers and/or FCS partners to complete your project successfully.

To get a system, the above team will discuss with you a system specification, from which a proposal and quote is developed. If the parameters and job description are agreed upon, engineering status reports are set up to keep you informed of the project progress along with an integration plan and delivery schedule.

When you plan to implement a complex Fluke instrument system, count on our System Integration Group for help. We offer professional consultation for both system software design and hardware configuration. We can help ensure your design decisions produce the most effective system for your equipment investment.

Our consulting service includes assistance with the overall design of a system as well as with coding and peripheral integration. We help you select the right Fluke instrument and show you how to expand and enhance your system with options and accessories.

Let Fluke help you maximize your system's capabilities. When you take advantage of Fluke's expertise you can be confident that your system design will reflect the latest technology configured to precisely match your application.

Call toll free (800) 443-5853, ext. 73 for information.

System Warranty

Notwithstanding any provision of any agreement the following warranty is exclusive:

The John Fluke Mfg. Co., Inc., warrants the system it manufactures to be free from defects in material and workmanship under normal use and service for the period of 90 days from date of installation. Software is warranted to operate in accordance with its programmed instructions on appropriate Fluke Systems; it is not warranted to be error free. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, flexible disks or contents thereof, or any product or part which has been subject to misuse, neglect, accident or abnormal conditions of operations or handling.

In the event of a failure covered by this warranty, the John Fluke Mfg. Co., Inc. will repair the system on-site within 90 days from date of installation; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the system in lieu of repair. With regard to any system repaired on-site within 90 days from the date of installation, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident or abnormal conditions or operations, repairs will be billed at a nominal service cost. In such case, an estimate will be submitted before work is started if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS OR ADEQUACY FOR ANY PARTICULAR PURPOSE OF USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.

Customer Training

Customer Training

- Product Applications Courses
- General Technology Workshops
- Maintenance Training
- Special customer training packages

Training Pays Off In Productivity

Fluke Customer Support Services is dedicated to providing information, assistance, and training for people who use and maintain Fluke and Philips products. As a designer and manufacturer of sophisticated instrumentation, we recognize that well trained technical people are an asset which is essential to productivity.

To gain maximum performance and productivity from your Fluke and Philips equipment, spend just a few days training with our experts. Our Product Applications Courses, General Technology Workshops and Maintenance Training courses combine comprehensive lectures with hands-on experience that will provide a sound understanding of both our equipment and documentation.

Product Application Training

Whether you've just purchased Fluke products or you already own them, our Applications Training will help you to enhance their effectiveness by taking advantage of every advanced feature.

1722/1752 Applications
2452 Applications
7411 Procedure Writing
NEW 900 Dynamic Troubleshooting
9010 Troubleshooting
9010 Programming
9100 Applications
9100 Programming
FlexSys Software
70 Series Solutions (self-paced course including workbooks or video-based course with instructor manual and overheads)

General Technology Workshops

The Fluke company is recognized as a leader in the test and measurement industry. The General Technology Workshops are designed to share our expertise in design, manufacturing, service and calibration. You will not only gain an understanding into the application of specific Fluke and Philips equipment but also explore concepts and ideas through the use of interactive hands-on exercise.

Principles of Metrology
NEW Calibration Lab Management
NEW Atlas Programming
NEW Principles of Microprocessor Systems
NEW Principles of Logic Analyzers
NEW Principles of Analog Scopes
NEW Principles of Digital Scopes

Maintenance Training

If you repair your own equipment, our Maintenance Training courses give you the opportunity to learn about the technology behind the features and functions, and help you to effectively troubleshoot and maintain even the most complex systems. These classes are unscheduled. Call to set up a class.

1722 Maintenance
2280 Maintenance
3040/50 Maintenance
3200 Maintenance
5100 Maintenance
5200 Maintenance
5205 Maintenance
8000 Maintenance
8500 Maintenance
8840 Maintenance

Free Training Certificate Program

When you purchase the following Fluke products, you are entitled to receive one special certificate to attend a related Product Application Course. The certificate allows you, as a Fluke customer, to waive the tuition*. This special program ensures that you get the most out of your purchase. Ask your Fluke Sales Representative for your certificate today or call 1 (800) 443-5853 ext. 73 for help.

Product	Course
900	900 Dynamic Troubleshooting
9005/9010A/ 9020A	9010 Board Tester Troubleshooting
9100A	9100 Board Tester Applications
9100-004/ 9100-005	9100 Board Tester Programming
9100A/SYS	Both 9100 Board Tester Troubleshooting and Programming
1790A-400/ 1790A-500	FlexSys Software Programming
A123	7411 Calibration Systems Software Applications

**Only one certificate per instrument/system purchased.*

Schedule

We schedule our courses throughout the United States and Canada for your convenience. Dates, fees and locations are shown in The Fluke 1989 Course Planner available from your Fluke Sales Representative.

Your Fluke Sales Representative can also provide data sheets with detailed course descriptions, outlines and prerequisites. We recognize that our scheduled classes may not fit your needs or schedule. That's why we offer On-Site and Unscheduled Training.

On-Site Training

If our scheduled courses are not convenient or you want to train a larger group of people, an on-site course is an easy, economical solution at your location.

Unscheduled Training

Unscheduled training courses for up to ten of your people can also be given at one of the designated Fluke training facilities.

For more information on unscheduled training and on-site training contact one of the Training Coordinators.

At Fluke we believe that our customers purchase more than just a piece of test equipment. We are committed to providing solutions that meet your requirements. **To order call toll free 1 (800) 443-5853, ext. 73.**

Training Coordinators

Irvine, CA (714) 863-9031
Chicago, IL (312) 705-0500
Paramus, NJ (201) 599-9500
Toronto, ONT Canada (416) 890-7600

Product Application Courses

1722/1752 Instrument Controller

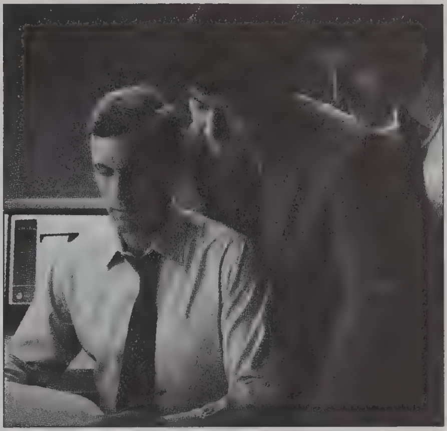
Software and Applications

Course Objectives: This Applications Training course will detail the 1722's approach to controlling system operations through skills gained in software programming and hardware configuration of the unit. With an understanding of the standard hardware components, available options, and the configurations of those options, you'll gain insights to your particular application needs. The software training includes complete coverage of FDOS (Fluke Disk Operating System), System Utility Programs, and Fluke Extended BASIC, all of which are available to the user. Graphic capabilities, Menu creation, and Touch Sensitive Overlay software commands are detailed and explored.
Prerequisites: You should be familiar with the BASIC programming language and the operation of measurement/sensor types of equipment (i.e., thermocouples, transducers, thermistors, RTDs). Knowing another programming language would be beneficial, but is not mandatory. A background in electronics would be helpful, but not necessary.
Who Should Attend: Operators, programmers, managers, and supervisors who have a need to operate, program, or interface the 1722/1752 Instrument Controller to their particular application.
Course No. 1722TAF/5 Days $1250

2452 Measurement Control System

Software and Applications

The 2452 Measurement Control System is one which combines a 2400B Intelligent Front End Computer and either a 1722A or a 1752A Instrument Controller. When linked together and configured to the particular application, the 2452MCS is a powerful measurement, data acquisition, and control system.
Course Objectives: This intensive 5-day course will cover the utilities, graphics, hardware configurations, program development, and various customer applications of this system as they relate to data acquisition and controlling tasks. During the first three days the utilities of the 1722A/1752A will be detailed. The remaining two days will deal with the 2400B, its various configurations, and machine control language.



Prerequisites: You should be familar with the BASIC programming language and the operation of measurement/sensor types of equipment (i.e., thermocouples, transducers, thermistors, RTDs). Knowing another programming language would be beneficial, but is not mandatory. A background in electronics would be helpful, but not necessary.
Who Should Attend: Technicians, engineers and managers who have a need to operate, program, or interface the 2452 to their particular application.
Course No. 2452TAF/5 Days $1250

7411 Calibration Systems Software

Applications

Course Objectives: While attending this five day course you will become familiar with the 1722A Controller Hardware and System Software. You will learn how to configure, install and use the 7411B Software Set. You will develop Performance Tests and Calibration Procedures, effectively using the equipment that is normally installed in your system. "Closed Loop" calibration techniques will be examined including techniques that may be used to insure operator safety and testing accuracy. Calibration History Management will be discussed including the options available for dealing with same.
Prerequisites: You should have an elementary understanding of calibration practical applications and practices. Computer and/or ATE system experience is not required. A working knowledge of your company's policies and practices in calibration would be beneficial but not absolutely necessary.
Who Should Attend: All professionals who are involved in the everyday programming and control of the 7411A/B Software installed in a 7404A, 7405A, 7409A, 7410A, 7449A or, an A123 Custom Calibration System.
Course No. 7411TAF/5 Days $1250

NEW 900 Dynamic Troubleshooting

Course Objectives: In this two day introductory course the student will learn the principles of operation, sequence programming, and troubleshooting with the Fluke 900 Dynamic Troubleshooter. They will learn to use the various features and functions of the 900 including Dynamic Reference Comparison, setting Performance Envelopes, and Sequencing.
Prerequisites: None.
Who Should Attend: Design engineers, manufacturing test engineers, and anyone responsible for troubleshooting and/or repairing microcomputer circuits.
Course No. 900TGF/2 days $495

9010 Board Tester

Troubleshooting

This course was designed to provide your personnel with the problem solving methodology needed to stay current in today's microcomputer technology. Whether you're doing service repair, assembly line pre-testing, or debugging newly designed circuits still on the breadboard, you'll find this course extremely useful when dealing with complex microcomputer circuits. By being able to quickly and methodically troubleshoot to the component level you'll see confidence and productivity rise and costs fall.
Course Objectives: In this two day course you will learn to use the 9010A to troubleshoot to the component level using actual microcomputer boards. Using the built in tests and error messages, you will apply the 9000 Series Troubleshooting Strategy to isolate actual hardware problems in a hands-on environment. Testing of I/O LSI devices and the use of the Asynchronous Signature Probe option are heavily emphasized.
Prerequisites: An understanding in the basic operation of microprocessor bus structured circuitry.
Who Should Attend: Design engineers, manufacturing test engineers, test/repair technicians, service engineers and anyone responsible for troubleshooting and/or repairing microcomputer circuits.
Course No. T9000TAF/2 Days $495

9010 Board Tester

Programming

Course Objectives: This course will stress programming techniques that will make using the 9010A both easier and faster. You will participate in the development and testing of Utility Programs, which will be used as the building blocks toward a full functional test. Included in the course will be a review of troubleshooting operations, hands-on circuit experience, and actual applications aimed at testing and troubleshooting I/O devices.
Who Should Attend: Design engineers, manu-

facturing test engineers, service engineers.
Course No. T9001TAF/2 Days $495

9100 Board Tester
Applications

Course Objectives: In this two day intensive hands-on training class the student will learn to develop a systematic approach to test strategy development using the 9100 immediate mode of operation. Specifically the student will use emulative testing to functionally test digital circuits. They will learn to recognize circuit failures using built-in diagnostics, signature analysis, level detection, frequency and overdriving techniques.
Prerequisites: An understanding in the basic operation of microprocessor bus structured circuitry.
Who Should Attend: Design engineers, manufacturing engineers, service engineers.
Course No. 9101TAF/2 Days $495

9100 Board Tester
Programming

Course Objectives: In this five-day intensive hands-on training class the student will learn to develop a systematic approach to test strategy development using the 9100 programming environment. Specifically the student will use the 9100 editor to develop programs designed for fault isolation and functional test. They will develop all of the data base elements and perform fully automated guided fault isolation, simple GO/NO-GO functional test, and full diagnostic software enhancing the efficiency of the 9100 backtracing algorithm. The student will develop models for fault isolation programs and fault handling diagnostics that will apply directly to their UUT applications.
Prerequisites: Completion of the 9100 Applications Introduction or 9010 Troubleshooting course. The student should also have experience in a higher level language such as: Pascal, C, or Basic.
Who Should Attend: Design engineers, manufacturing engineers, service engineers.
Course No. 9100TAF/5 Days $1250

FlexSys
Software Programming

This ten-day course studies the advantages of the FlexSys ATE Workstation environment over the present ATLAS development systems by learning the functions of each of the components of the FlexSys System.
Course Objectives: The course discusses the software development environments and the execution of ATLAS/FlexSys procedures on a working ATE system. Emphasis is placed on hands-on program development and will cover the structure and syntax of:
- ATLAS/FlexSys language
- Resource Description language and formation of the RD library
- Assignment Files
- Configuration of the ATE system
- Linking of non-ATLAS procedures to the ATLAS procedures
- Summary file

Prerequisites: The course is very programming intensive. Approximately 40% of the class time is used for procedure writing and programming tasks. Because of this the student should have knowledge or experience with programming. Additionally, the student must have a working knowledge of Automated Test Equipment and how to design an ATE procedure using a programming language. The student must also have a working knowledge of standard computer utilities such as file transfer, display editors, file management, compilation routines, and I/O device management. Although it is not necessary, the student would be more comfortable if he had a basic familiarity of the ATLAS language, since FlexSys is an implementation of Common ATLAS. It would also be beneficial if the student had experience in the remote programming of digital multimeters, instrument controllers, power supplies, and analog system integrators.
Who Should Attend: The FlexSys course is useful to test and programming engineers and technicians who are familiar with IEEE remote controlled test instrumentation configurations and who have a need to develop ATLAS compatible procedures for government submission.
Course No. 1790-TGF/10 Days $2500

70 Series Solutions

This is a unique course that user's or schools can utilize to train themselves on Fluke's most popular digital multimeter, and gain knowledge in basic DMM technology.
- Student workbook sets
- Instructor manual and overheads
- Video tape

The Fluke 70 Series Training Package, explains how to use a multimeter to measure voltage, current and resistance as check diodes and transistors. This course covers the questions of "why" as well as explaining "how". Why can a current meter damage a circuit under test? Why doesn't the measured value of an in-circuit resistor match the value of the resistor's color code? Why do some voltages produce readings on both the ac and dc voltage functions of a multimeter? Understanding the "whys" of multimeters will aid you in interpreting measurements and test results from electronic circuits.

Anyone with a basic understanding of electronics can use this self-paced and instructor run course for training on the 70 Series Multimeters. The explanations given assume that you have the knowledge of the following concepts:
- Ohms Law: The relationship between voltage, current, and resistance.
- Parallel Resistance: Total resistance decreases as more parallel branches are added.
- dc and ac: DC is direct current, which does not change in amplitude or direction. AC is alternating current, which changes in amplitude and direction over time.
- Shorts and Opens: A short has no resistance. An open has infinite resistance.
- Use of an Oscilloscope and signal Generator: Two of the Hands-On Training exercises involve the use of an oscilloscope and signal generator. These exercises can be omitted, if necessary. Or, one person who knows how to use the scope and generator can take charge of operating them.

You can use this textbook even if you have little experience in electronics. The textbook is suitable for anyone who uses or will be using a multimeter: students, electronic assemblers, technicians, automobile service persons, hobbyists, etc. Even if you have considerable experience with electronics you may learn something new. It's surprising how many people working in the electronics field aren't sure how to use a current meter properly or don't know how to use an ohmmeter to test a diode.

The total set costs $225 plus shipping & handling (Part Number 833004). You can buy separate pieces as well: Set of 25 student workbooks -$62.50 (Part Number 832998), video tape - $85 (Part Number 833244). Call the Fluke Service Parts Center at (800) 526-4731. From Alaska, Hawaii or Washington call (206) 356-5774.

General Technology Workshops

Principles of Metrology
General Technology

Course Objectives: Principles of Metrology is a one-week course covering electrical/electronic measurements and calibration. Participants will become more productive in calibrating test instrumentation. The course includes practical tips and exercises to illustrate:
- Loading Errors
- Lead Impedance
- Using Voltage Dividers
- Low Level Measurements
- Thermal EMFs
- Grounding and Guarding
- Measurement System Uncertainties

The student will also be introduced to "Creative Metrology." Creative Metrology is an innovative way of approaching the task of measurement from different points of view and extending the range of NIST (NBS) traceability. The kind of thinking and techniques required to extend measurement parameters are dealt with in detail. The student will begin to see and use creative techniques for their measurement and calibration requirement.
Prerequisites: None.
Who Should Attend: Engineers and technicians with an electronics background whose work involves measurements and calibration.
Course No. T1000TGF/5 Days $1250

NEW Calibration Lab Management

Course Objective: Students will learn the requirements of establishing and operating a calibration laboratory. Along with the requirements, they will acquire the tools which will help them

organize, develop, and arrange a laboratory from the entreprenurial point of view.
Prerequisites: None.
Who Should Attend: Managers and technicians involved in setting up a new cal lab for their company, or those presently involved in cal lab management but need some new ideas or a new perspective in solving particular problems in their existing operation.
Course No. 1005TGF/5 Days $1250

NEW Atlas 716 Programming

Course Objectives: This one-week course covers the IEEE standard 716 ATLAS language. Students will learn ATLAS program structure, syntax, and applications through lectures, audio-visual presentation, and hands-on laboratory exercises.
Prerequisites: The course is very programming intensive. Approximately 40% of the class time is used for procedure writing and programming tasks. Because of this the student should have knowledge or experience with programming. Additionally, the student must have a working knowledge of Atlas, Automated Test Equipment and how to design an ATE procedure using a programming language. The student must also have a working knowledge of standard computer utilities such as file transfer, display editors, file management, compilation routines, and I/O device management. It would also be beneficial if the student had experience in the remote programming of digital multimeters, instrument controllers, power supplies, and analog system integrators.
Who Should Attend: Programming engineers and technicians requiring a working knowledge of the IEEE-716 subset of the ATLAS language and who need to develop ATLAS test procedures for government submission.
Course No. 716TGF/5 Days $1100

NEW Principles of Microprocessor Systems

General Technology

Course Objectives: This is a two day course which covers the basic elements of microprocessor systems. Starting with discussions of the binary and hexadecimal numbering systems, the course continues on through bus descriptions, microprocessor operation, system timing, multiplexing, instruction sets, mnemonics, and opcodes. Students will learn to write programs in machine language, and will be completely familiarized with the architecture of a variety of different microprocessors. Hands on exercises involving the Fluke 90 and 9000 Series digital test equipment augment lecture topics.
Prerequisites: None. This two-day seminar is recommended as a precursor to Fluke's 900/9000/9100 Series Applications and Programming courses as well as being an introduction to microprocessor-based systems in general.
Who Should Attend: Engineers and technicians who are involved in the troubleshooting of microprocessor systems. Also, those who are involved in research and development who need to accelerate their learning curve to become more productive.
Course No. 1001TGF/2 Days $495

NEW Principles of Logic Analyzers

General Technology

Course Objectives: This course provides an excellent background in the operation and use of logic analyzers. Basic microprocessor theory is covered first, and then a program development system is used to write and run machine language programs written by the student. The results of these programs are monitored by a logic analyzer to learn both the nature of the programs, as well as the detailed operation of a logic analyzer. In addition, applications of a logic analyzer for troubleshooting microprocessor systems is also covered.
Prerequisites: Students should have taken the course on Principles of Microprocessor Systems, or have a good knowledge of microprocessors from other courses, or experience.
Who Should Attend: Engineers and technicians who are involved in any of the areas of design engineering, program development, or servicing of microprocessor systems. In general, those who see the need to use a logic analyzer, but require an understanding of the "mysteries" of such a powerful tool.
Course No. 1002TGF/4 $995

NEW Principles of Analog Oscilloscopes

General Technology

Course Objectives: This course is designed to provide the technician/engineer with an in-depth understanding of analog oscilloscope operation. An insight is provided to the inner workings of the vertical and horizontal deflection systems as a prelude to understanding applications. Other features such as the Triggering System and the Delayed Time Base System are covered via complete block diagrams so that their use can also be related to applications. One area of discussion involves the many measurement pitfalls which can be encountered, and how to avoid them. Interspersed with the lecture discussion are many hands-on exercises to ensure that the student fully understands the application involved.
Prerequisite: None.
Who Should Attend: Personnel who need familiarization with the more up-to-date oscilloscopes. Also, those who need a refresher course on scopes, and information on ways to better utilize an oscilloscope.
Course No. 1003TGF/2 Days $495

NEW Principles of Digital Oscilloscopes

General Technology

Course Objectives: Many functions of an oscilloscope are never used because the operator is either unaware, or unknowing with regard to their application. This course will bring all students up-to-date in the complete operation and applications of the digital oscilloscope. Technicians or Engineers who are new to the operation of Digital Oscilloscopes can benefit greatly from this course. In addition, those who need a refresher course on the many ways to use a digital scope can use this course as a means to get "up to speed" in a hurry.
Prerequisite: None.
Who Should Attend: Personnel who need familiarization with the more up-to-date oscilloscopes. Also, those who need a refresher course on scopes, and information on ways to better utilize an oscilloscope.
Course No. 1004 TGF/2 Days $495

Maintenance Training

(Unscheduled)

1722 Instrument Controller

Maintenance

Course Objectives: These two separate one-day courses will give you not only an extensive amount of hands-on operating time in which to gain experience and confidence on the use of the equipment, but you'll also troubleshoot the instrument to the module level. The use of built-in diagnostic capabilities will be covered in addition to the troubleshooting procedures.
Prerequisites: A formal education in digital and analog electronics theory. You should possess practical troubleshooting experience and a good working knowledge of basic test equipment used in measuring voltage, current, resistance, and waveforms.
Who Should Attend: Anyone who has a need to operate or repair their 1720 or 1722 Instrument Controller.
Course No. 1722-TMF/2 Days $495

2280 Data Logger

Maintenance

Course Objectives: This five-day maintenance training course will present to the student all the information needed to repair the unit to the module level. The practical aspects of maintenance and hands-on exercises are highly stressed. Given a defective 2280 Data Logger, a set of Manuals, tools and test equipment you will be able to repair the 2280 to the module level.
Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, current, resistance, andwaveforms in a troubleshooting atmosphere.
Who Should Attend: Technicians and supervisors who are required to maintain, calibrate, and repair their equipment.
Course No. 2280TMF/5 Days $1100

Customer Training

3040/3050 Board Tester
Maintenance

Course Objectives: Prepared with an understanding of the system layout, service manual organization, theory of operation, self test diagnostic operation, servicing techniques, adjustment procedures, and mechanical assemblies, it is the intention of this five day course that you be able to maintain and repair the 3050B to the major subassembly or board level.

Prerequisites: A formal education in electronics, including digital and analog theory. Practical hands-on experience troubleshooting complex systems. A working knowledge of basic test equipment used to measure voltage, current, resistance, and waveforms is a must. Additionally, a working knowledge of 3050 operation and programming is strongly suggested.

Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 3040/3050 Series equipment.

Course No. 3040TMF/5 Days $1100

3200 Board Tester
Maintenance

Course Objectives: Prepared with an understanding of the System Component locations, Theory of Operation, Special Diagnostic utility programs, Alignment checks and Troubleshooting Tests, it is the intention and objective of this five day course that you be able to maintain and repair the 3200B Manufacturing Defects Analyzer to the Subassembly, board, or module level.

Prerequisites: A formal education in electronics, including digital and analog theory. Practical hands-on experience troubleshooting complex systems. A working knowledge of basic test equipment used to measure voltage, current, resistance, and waveforms is a must. Additionally, a working knowledge of 3200 operation and programming is strongly suggested.

Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 3200B Series equipment.

Course No. 3200TMF/5 Days $1100

5100 Meter Calibrator
Maintenance

This five-day maintenance course is provided for those who wish to troubleshoot and repair their 5100 Series Meter Calibrator to the component level. The models covered in this course are the 5100B, 5101B, and 5102B.

Course Objectives: A thorough block diagram analysis, theory of operation, and troubleshooting discussion will provide the confidence needed to accomplish the troubleshooting and repairing of malfunctioning 5100 units. Intensive hands-on exercises will support the confidence level of each student.

Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, current, resistance, and waveforms in a troubleshooting atmosphere.

Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 5100 Series equipment.

Course No. 5100TMF/5 Days $1100

5200A Programmable AC Calibrator
Maintenance

This five-day maintenance course is provided for those who wish to troubleshoot and repair their 5200A AC Calibrator to the component level.

Course Objectives: A thorough block diagram analysis, theory of operation, and troubleshooting discussion will provide the confidence needed to accomplish the troubleshooting and repairing of malfunctioning 5200A units. Intensive hands-on exercises will support the confidence level of each student.

Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, current, resistance, and waveforms in a troubleshooting atmosphere.

Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 5200A equipment.

Course No. 5200TMF/5 Days $1100

8000 Series Digital Multimeter
Maintenance

Course Objectives: At this program, students will learn to

1) operate the 8000 Series Digital Multimeters to gain experience and confidence in their capabilities,
2) verify proper operation,
3) troubleshoot to the component or module level.

Prerequisites: Training in digital and analog electronics theory. Practical troubleshooting experience in complex systems and a working knowledge of basic voltage, current, resistance, and waveforms measurement equipment. A basic understanding of meter calibration sources or calibration laboratory experience is helpful but not required.

Who Should Attend: Technicians or supervisors who maintain the efficiency of the Fluke 8000A/8030A, 8010A/8012A, 8020A/8021B/8022A & B/8024A/8026A & B, 8040A/8050A, and 8060A/8062A Digital Multimeters.

Course No. 8000TMF/3 Days $700

8500 Digital Multimeter
Maintenance

This training course will include maintenance on the 8500 Series DMMs. The models included in the course are the 8500A, 8502A, and 8506A.

Course Objectives: This five-day maintenance course is designed to give you the confidence to successfully troubleshoot the 8500 Series Digital Multimeters. Depending on your entry level, this troubleshooting will be accomplished to either the component or the module level.

Prerequisites: A formal education in digital and analog electronics theory. You should possess practical troubleshooting experience and a good working knowledge of basic test equipment.

Who Should Attend: Anyone desiring the information needed to repair their malfunctioning 8500 Series DMM.

Course No. 8500TMF/5 Days $1000

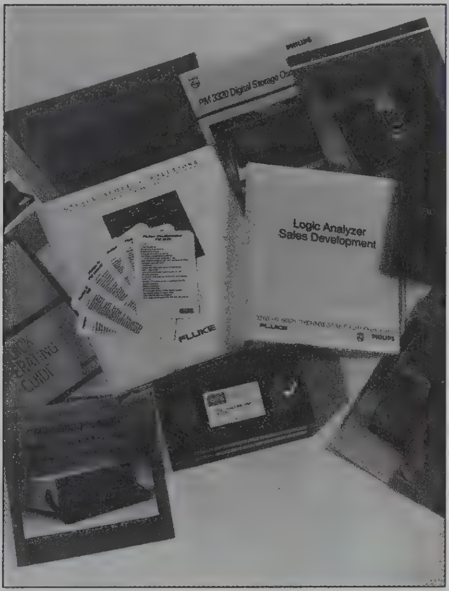
8840A Digital Multimeter
Maintenance

Course Objectives: In this four-day course you will learn to operate, calibrate, and maintain the 8840A. Additionally, you will learn to troubleshoot the unit to the component level.

Prerequisites: A formal education in digital and analog electronics theory. You should possess practical troubleshooting experience and a good working knowledge of basic test equipment used in measuring voltage, current, resistance, and waveforms.

Who Should Attend: Anyone who has a need to operate, calibrate, or repair their 8840 DMM.

Course No. 8840TMF/4 Days $920



Education Programs

Educational institutions face a tremendous challenge training tomorrow's electronic engineers and technicians. Continuous growth in technology along with perennial budgetary constraints make the educator's job of defining an electronic curriculm, choosing the right equipment and keeping that equipment in good working order a difficult task.

For many years Fluke and Philips have been working with many educators in facing this important obligation. Fluke's Educational Support Programs are centered around a broad array of rugged, high performance instruments, a worldwide network of service and support, a series of comprehensive training materials, all at competitive prices.

Product Reliability

Fluke and Philips are recognized in the electronics industry as premier suppliers of high performance industrial-grade test instrumentation, designed and built strong enough to take the toughest abuse. We recognize that a test instrument's application ranges from the laboratory to the production floor to remote field service sites and that users range from the highly skilled test engineer to the first-time technical trainee. Therefore, we design and build our instrumentation to be intuitively easy to use and to be able to withstand both physical and electrical mis-use. Most of our instruments meet or exceed the safety specifications outlined by UL, CSA and the European VDE. And our MTTF (Mean Time To Failure) specs attest to our rigorous design and Quality Control standards. In support of these claims for reliability, all of our instruments are backed by one-, two- or three year warranties.

Inherent quality and reliability pays big dividends in the classroom, where students subject equipment to heavy use, and sometimes, misuse. Where budgets for equipment maintenance, repair and calibration are limited, rugged, reliable instruments that keep on working can make a difference in today's full curriculums.

Product Breadth

Today's electronic education ranges from basic electrical theory to advanced electronics research. Fluke and Philips offer a broad array of instrumentation to meet these classroom and laboratory needs, all offering exceptional value.

Our products include real-time (analog) and storage oscilloscopes (analog and digital), handheld and bench digital multimeters, frequency counters and counter/timers, function generators, synthesized signal generators, digital testers, component testers (RCL Meters) and data acquisition equipment.

Of particular interest to those educators moving their students from the analog into the digital world are our oscilloscopes and DMMs that combine both analog and digital capability. Using both measurement modes, one gains a strong understanding for the vital aspects of the growing digital domain.

Today's electronic world increasingly requires that instruments and computers "talk" to each other via IEEE-488 or RS-232 links. The practical teaching of such concepts has been hampered until now by the complexity and high cost of such instruments and systems. Now, however, significant changes have made such teaching both more practical and affordable. Fluke/Philips offers the broadest array of low-cost building blocks for PC-based IEEE test systems available from any supplier in the world.

These building blocks include test instrumentation software (e.g., Test Team), IEEE-488 cards, modular interconnect switches (System 21), digital oscilloscopes, digital multimeters, counters, function generators, logic analyzers, microprocessor testers and more.

Whether your curriculum covers basic electronics or IEEE systems, your Fluke/Philips sales engineer can work with you, defining the equipment that best meets your needs.

Worldwide Support

When you choose a test equipment vendor, the product is just the first step. Fluke and Philips understand that selecting a vendor who backs that product with capable technical assistance and reliable, rapid and afforable service is a critical issue in your decision. Fluke and Philips rank "number 3" in sales of test instrumentation worldwide. That makes us large enough to have a network of service and support facilities to fully serve our cutomers yet small enough to give that "extra measure" of customer care long after the sale is concluded. For 40 years we have lived by the motto that we "... give the Customer a little bit more than he thought he paid for". Everyday, all of us at Fluke/Philips work hard to insure this motto gets translated into true customer satisfaction. (See previous Calibration & Repair Section for our array of flexible service agreements and plans.)

Training Tools

With the rapid changes in technology and electronics, schools are faced with a real dilemma in keeping their curriculum and the talents of their staff, up to date. Given today's increasingly powerful, complex instrumentation, this task becomes even more acute.

Fluke and Philips can help with an extensive array of training aids, including Basic Principles books, application notes, Quick Operating Guides, instruction manuals, service manuals and video tapes. In addition, a variety of product application courses, general technology workshops and maintenance training are also available.

One new course is specifically designed for instruments in educational institutions: 70 Series Solutions. The 70 Series has been Fluke's standard in digital multimeters, with industry using over a million units.

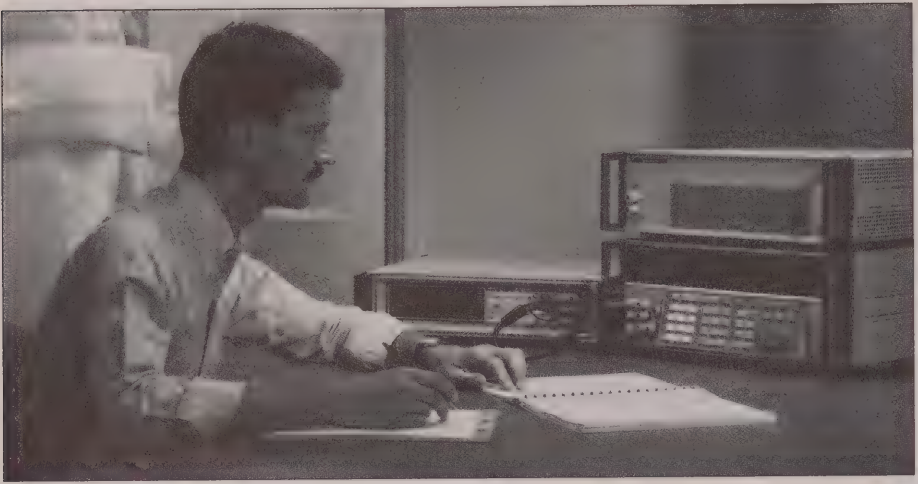
Fluke has created this instructor package, including instructor manual, training overheads, video tape and student workbooks. You can get started quickly in setting up this core, hands-on electronics lab, with an instrument that is widely used throughout the electronics test world.

Exceptional Value

The Fluke and Philips companies have built their reputation by serving customers with products of exceptional value — high performance, proven reliability and fair prices. Nowhere is this more important than in educational institutions. In addition to products of superior value, we also support the teaching community with a series of **EDUCATIONAL DISCOUNTS, GIFTING PROGRAMS, EXTENDED PRODUCT SUPPORT PLANS and TRAINING PACKAGES** designed specifically for education.

To see how we can effectively address YOUR teaching needs, contact your local Fluke sales office or call 1-800-443-5853, ext. 73.

Metrology Services



Metrology Services

- State-of-the-art, primary standards laboratory
- NIST (NBS) traceability
- Cost-effective convenience
- Two key customer-oriented programs
- Preparation for the "1990 Electrical Unit Change"

Fluke brings you the convenience of true service, with the highest accuracy standards. Our goal is to help you make your calibration lab the best it can be.

Our metrology services continue to expand to meet your needs.

Traceability Maintenance Programs

- DVMP
- 5700A Cal Package

These innovative, on-site calibration services are offered to Fluke customers as a convenient means for maintaining traceability for your most accurate electronic measuring equipment.

Direct Voltage Maintenance Program

The Direct Voltage Maintenance Program has been in operation since 1984. This popular on-site service provides you with near - NIST (NBS) accuracy for the 10 volt output of your DC reference standard without the inconveniences, cost and loss of use of sending your standard to NBS. For a complete description of this program, see page xxx.

Traceability Maintenance Programs for alternating voltage and for resistance are under development, and are expected to be available by mid 1989. For information on any of these programs, call (800) 443-5383, ext. 73.

5700A Artifact Calibration Package

Designed for the smaller facility which does not want the expense of owning and maintaining the 10 volt standard and resistors needed for periodic "Artifact Calibration" of the 5700A, this service will be available about March, 1989. We will send you a characterized 732A, 742A-A and 742A-10K plus the connecting cables and instructions you will need.

Standards Calibration Services

Send in your standards, we measure them and report their value. If it requires repair, arrangements are made with you to most effectively bring your standard back into specification. For more information on availability and price, phone (800) 443-5853, ext. 73.

The Changing Volt

What's Happening

On January 1, 1990, the world will adopt a new worldwide standard of voltage. The change from the old standards is being made so everyone will have the same volt and instruments calibrated in one country will measure accurately in another.

At present, there are several "volts", each slightly different from the U.S. volt, and nearly 8 ppm different from the SI volt, which is the "real volt". In January 1990, each country will adjust its volt by the amount needed to make it correspond to the SI volt. In Canada and Europe, the change will be about 8 ppm, in the U.S., about 9 ppm.

Small changes will be made in the values of the ohm, kilogram and the temperature scale at the same time. The amount and direction of all these changes will be decided in late 1988 or early 1989.

How Will It Affect You?

Many calibrators and meters have enough accuracy that a change of 8 or 9 ppm in their calibration will be enough to seriously affect their ability to perform to specifications. These instruments must be identified and steps taken to prevent erroneous measurements. Other quantities will also change because of the change in the volt. These include the ampere and the watt.

As a rule, any instrument having specified uncertainty of +/- 50 ppm or less for direct voltage, alternating voltage, AC or DC current or power will require action to prevent errors. Some instruments having uncertainties between 50 ppm and 100 ppm MAY be affected. These instruments should be identified and looked at on an individual basis.

It will be impossible to recalibrate all the affected instruments at once, so there will be a transition period in which both volts exist in the same facility. To avoid mistakes, instruments must be clearly marked to show which volt is being used. Standard stickers will be made available for marking instruments calibrated to the old volt and to the new volt.

Changes in the ohm, the kilogram, and the temperature scale will be too small to impact large numbers of instruments. The effect of these changes will hardly be felt outside the standards laboratory, and there they will most likely be handled by means of paperwork changes to the values assigned to standards which maintain those quantities.

How Will Fluke Help?

Fluke engineers and metrologists participate on the committee NIST (NBS) set up to ease the transition to the new units, and is in close contact with what is happening. Fluke will offer several programs to assist you in making the change easily and economically:

- Fluke customers will be sent the necessary information and instructions as they become available.
- Fluke will make available the "new volt" and the "old volt" stickers.
- After mid-1989, Fluke instruments will be shipped with the "old volt" stickers. When the change is made at Fluke, instruments will be shipped with the "new volt" sticker.
- The Fluke Direct Voltage Maintenance Program is prepared to assist you in adjusting your most accurate voltage standards.
- The Fluke Technical Centers are ready to help you recalibrate your workload of meters and calibrators.

Technical Literature Available

Service Information

Ask your local Technical Center for a copy of any literature you may need. Or use a reply card, if you prefer. Please use both title and number.

Digital Multimeters and Voltmeters

Auto-Zero Circuit 8300A, Inverting Amplifier	C0045
Digital Voltmeter Guard Terminal Connection	C0048
Installation of Fuse Holder in the 8300A MV/Ohm	C0055
Troubleshooting the 8500A Utilizing Its Modular Structure	TB-10
Use of Millivolt/Ohm Option for 8300A DVM on 50 Hertz	C0047
1910/11A Counter Series	SB-75
80F-5/15 Improved Shock Protection	C0066
8000A Troubleshooting	TB-12
8000A Digital IC Replacement	C0062
8000A/mAS High Voltage Protection	C0065
802XB AC Reading During Overloads	C0092
8100A Battery Pack Recharge Cycles	C0053
8100A Battery Pack Repair and Replacement	C0049
8100A In-Circuit FET Leakage Tests	C0044
8100A, 8110A, 8120A, 8125A AC Linearity Tests	C0050
8100A, 8110A & 8120A 1000 Range Hi-Pot Failure	C0054
8030/8040 Battery Fuse Protection	C0069
8500A Calibration Memory Battery Replacement	C0070
8800A Ohms Converter Replacement	C0068
931A Digit Switch Installation Instructions	C0042

Calibration

Improving Reliability in Systems Use of 3330B	C0082
332B/D; 335A/D Calibration Access Warning Decal	C0072
332D & 335A Replacement of Lamps w/LEDs	C0063
330B Power Line Wiring Modification	C0060
3330B Reliability Improvements	C0088
341A/343A LED Replacement	C0084
5100 Series Plug-In Relay Replacement	C0073
5100 Troubleshooting Information	B0086
5100/5101 Power Supply Fuse Installation	C0087
515A Battery Pack Mounting	C0086
5200A Oscillator Assembly Component Selection	C0085
5205 Troubleshooting Notes & Procedures	C0083
5205A/5215A LED Loop Bandwidth Calibration	C0067
5205A/5215A Operating, Cleaning & Servicing Notes	C0080
5205A/5215A Reliability Enhancement	C0097
New Design Developments Simplify Calibrator Support	F0106
720A Linearity Drift with Time	C0058
760A Switch Maintenance and Replacement	C0043
7405A Automated Calibration System Preparation	C0094
7410A Automated Calibration System Preparation	C0089
The Life-Cycle Costing Approach to Instrument Selection	F0109

Data Loggers

2200B & 2240B Data Logger Memory Loss	C0076

High Voltage Power Supplies

Safety Check of Line Fuseholder Wiring (410B)	C0079
415B Over Current Modification	C0052

General

Component Replacement Techniques	C0071
Fluke Instrument Switches	C0064
Preventing Electrostatic Damage During Service	C0081
Troubleshooting Into IEEE-488	C0076
Troubleshooting AC Converters	C0090
Preventive Maintenance for Internal Ni-Cad Batteries	C0093

Customer Support Services Data Sheets

Digital Multimeter Repair and Calibration	E0221
Fluke Module Exchange Program	E0031
Repair and Calibration Services	E0225
FCS – A Commitment to Systems Solutions	G0137
1722A Product Update	M0007
1722A to 1752A Product Update	M0009
2280A to 2280B Product Update	M0006
2400A to 2400B Product Update	M0008
5440A to 5440B Product Update	M0005

Applications Training Data Sheets

1722/1752 Instrument Controller Software & Applications Training	E0238
2452 Measurement Control System Software & Applications Training	E0241
7400 Series Calibration Systems Procedure Writing	E0229
2280A/B Data Logger Product Introduction	E0228
9010 Board Tester Troubleshooting Training	E0242
9010 Board Tester Programming Training	E0243
FlexSys Software Training	E0239
Metrology for Technicians	A0260

Maintenance Training Data Sheets

1722A Instrument Controller Maintenance	E0234
2280A/B Data Logger Maintenance	E0235
2452 Measurement Control System Maintenance	E0240
3040A/3050B Board Tester Maintenance	E0236
3200B Board Tester Maintenance	E0230
5100 Series Meter Calibrator Maintenance	E0231
5200 Programmable AC Calibrator Maintenance	E0227
8500 Series Digital Multimeter Maintenance	E0232
8840 Digital Multimeter Maintenance	E0233
8000 Series DMM Maintenance	E0237

Specials

Fluke Customer Training Brochure (multi-page)	E0224
Fluke 1988 Course Planner (poster)	O0016

Application Information

Ask your Sales Office or Representative for a copy of any literature you may need. Or use a reply card, if you prefer. Please use both title and number.

Microprocessor Board Testers: 90 Series

Emulation Testing of Microprocessor Based Equipment (EE 6/88)	F0110
Field Testing Before the Sale	F0111
Equipment Reports	F0112
Repairing Microprocessor-Based Equipment	F0113

Micro-System Troubleshooters: 9100/9000 Series

Remote Operation	B0147
9000/9100 Series User Designed Interface Pod Adapters	B0156
The Probe and the Program	B0163
Using the Fluke 9000 Series Micro-System Troubleshooter to Test and Troubleshoot Video Controllers	B0168
Portable Tester Learn Boards to Simplify Service (Electronics, 6/81)	F0016
KCST-TV 9010A Field Report (Broadcast Engineering, 10/85)	F0055
Taming SMD-Based Boards with Design for Test and Test Automation (Electronic Test 5/87)	F0072
Introductory Training Manual Micro-System Troubleshooters (9000A Series)	J0178
9100A Production Testing	L0030
Fluke Troubleshooter – A Collection of Articles for Micro-System Troubleshooter Users (Replaces all earlier newsletters):	
For all of 1983 issues	P0003
For all of 1984 issues	P0009
For all of 1985 issues	P0014

PC Board Testers: 3000 Series/3200 Series

Unconnected Output Errors	L0006
Counter Initialization Functional Testing (3000 Series)	L0010
Testing Static Memories (3000 Series)	L0014
Pin Electronics for the 3050A	L0016
Expanding Models 3040A/3050A to Test PCBs With More Than 240 Pins	L0018

Digital Multimeters and Voltmeters

Using the 8520A DMM's Math Programs	B0075
8520A Burst Measurements	B0107
Analog Bar Graph Applications Using Fluke 70 Series Multimeter	B0158
Automotive Applications for Fluke Multimeters	B0164
Electrical Troubleshooting With Fluke Multimeters	B0171
A Test Lab in Your Toolbox. The Fluke 8060A	B0172
The On-Site Fluke Story (Model 77) (Vector, May 1984)	F0036
Digital Multimeter Packaging Tackles Harsh Environments (Electronic Packaging & Production, 10/84)	F0045
Fault Protection for Digital Multimeters (Electrical Construction & Maintenance magazine, 2/87)	F0066
Reliability of Handheld DMMs (Quality magazine, 12/86)	F0067
How to Select a Multimeter	F0102
Selecting True RMS & Averaging DMMs	G0098
Multimeter Safety	G0101
The ABCs of DMMs	G0102

Calibration

Cost Optimized Calibration 5100B Series	B0055
Additional 7105A Calibration Techniques	B0141
Questions & Answers on the 5440A Direct Voltage Calibrator	B0152
Understanding the 5440 Series	B0170
Interpreting Specifications of Calibration Instruments	B0174
Calibration – Philosophy in Practice	E0010
International Standards - It is a Small World After All (Quality magazine, 8/86)	F0061
Is There a Need for a Calibration Lab? (Quality magazine, 10/86)	F0062
The Changing of the Guard: Buying the Right Calibration Instrument (Electronic Test, 12/86)	F0068
Calibrators/Calibration Standards. Are You Confusing the Calibrator With Calibration (EE 4/87)	F0069

Calibration Moves Out of the Laboratory (Test & Measurement World 5/87)	F0071
New Design Developments Simplify Calibrator Support	F0106
The Life-Cycle Costing Approach to Instrument Selection	F0078
Precision Direct Voltage and Ratio Calibration System with Standards Room Accuracy	L0020

Computer-Aided Calibration: 7400 Series/A123 Series

Automated Calibration System	L0021
Mobile Automated Calibration System	L0022

Instrument/System Controllers: 1720A/1722A/1752A

An Introduction to Virtual Arrays	B0143
Programming with Virtual Arrays	B0144
Plotter Routine Library	B0162
Interfacing with an Epson FX-Series Printer	B0166
ATLAS: Programming for ATE (Avionics Magazine, 1986)	F0060

Data Acquisition Data Loggers: 2280 SERIES/2200B/2240C

Road Testing With a Battery Powered 2280A Data Logger	AL-1041/D0027
Using the 2280A to Test a Fluidized Coal Pilot Plant	AL-1044/D0030
Using the 2280A to Test Digital Audio Disks	AL-1045/D0031
Using the 2280A Data Logger to Test Power Supplies	AL-1046/D0032
Using the 2280A Data Logger to Test Helicopter Air Speed Sensors	AL-1047/D0033
Data Logger Expands to 1500 Point/Data Acquisition and Control System (Control Engineering 9/82)	F0025
Data Loggers in Test Measurement (Test & Measurement World 9/83)	F0033
Trunk-Mounted Data Logger Road Tests Chrysler Cars (Industrial and Process Control magazine, 7/84)	F0043
Data Logger Helps Reduce Cost in Brewery (Industrial and Process Control magazine, 6/85)	F0052
2280A Data Logger Operator's Notebook	J0222

Data Acquisition/Computer Front Ends/ Process Control: 2400B/2452MCS

Intelligent Computer Front End – Software Dialog	A0202
For Fire Testing	AL-1032/D0018
To Monitor Remote TV Transmitting Stations	AL-1033/D0020
To Test Steam Turbines	AL-1034/D0019
To Control Hot Runner Temperatures in a Plastic Injection Molding Process	AL-1035/D0021
For Wire Harness Testing	AL-1036/D0022
To Monitor a Gas Pipeline Main Compressor Station	AL-1037/D0023
To Monitor a Steel Mill's Basic Oxygen Furnaces	AL-1038/D0024
To Control Stress and Rupture Testing Furnaces	AL-1039/D0025
Using the 2400A for Environmental Testing of Electronic Components	AL-1040/D0026
Using the 2400A to Monitor and Control Petrochemical Pilot Plants	AL-1042/D0028
Using the 2452MCS with Stepper Motor Controller Option to Run a Factory Pick-and-Place Machine	AL-1043/D0029
Using the 2400A Series for Gas Flow Metering & Control	AL-1049/D0035
Furnace Control and Monitoring	AL-1050/D0036
2400B-001 Serial Interface	B0159
Runnerless Tooling: A Fast and Reliable Way to Mold Any Material (Modern Plastics 10/83)	F0030
Flexible Test Systems Cut Costs and Hike Production-Line Turnarounds (Electronics 5/84)	F0037
Efficiency of Chemical Process Development Increased by Computerized Control System (Chemical Processing 10/84)	F0047
Programming Control Algorithms (Chemical Engineering magazine, 3/18/85) (incorrectly labeled as F005)	F0050

Touch-Control Equipment: 1020/1030 Series/1780A

Interfacing 1020 Series Touch Control Screens to Programmable Logic Controllers	L0023
Adding Touch Control Screens to Allen-Bradley Programmable Logic Control Systems	L0024
Fluke Touch Control Screens Provide Versatile New Operator Controls for Stamping Presses	L0025
Adding Touch Control to Texas Instruments Series 500 Controllers	L0026
Adding Touch Control Screens to Square D Programmable Controllers	L0027
Linking Data Collection Devices to the Fluke Touch Control Screens	L0031

Digital Thermometers

Total Instrument Accuracy for Digital Thermometers (Was AB-29)	B0005
Test or Calibrate Thermocouple or Millivolt Indicators (2190 + Y2003) (Was AB-47)	B0059
2300A Temperature Scanner: Typical PTI Applications (Was AB-51)	B0074
Case Studies in Temperature Measurement	AL-1048/D0034
Thermocouples, RTDs Can Boost Temperature Measurement Accuracy (Industrial Research & Development 11/83)	F0031
Fluke 52K/J Thermometer (Hands on Electronics 5/87)	F0070
The ABCs of Thermometers	G0145

Printers

"Computing" Printer Solution – Some Typical Instrumentation Applications (2030A) (Was AB-50)	B0068

Signal Sources

Systems Use of the 6011A Synthesized Signal Generator	AB-22/B0048
Signal Generator Primer	B0121
Filter Testing Using the 6070A and 6071A Synthesized Signal Generators	B0124
Delay Lines Give RF Generator Spectral Purity, Programmability (Electronics 8/80)	F0013
Low Cost Signal Generator Features 2.1 GHz Range and Pulse Modulation (rf design 4/87)	F0073

General

IEEE Standard 488-197 Digital Interface for Programmable Instrumentation	AB-36/B0053

GPIB System 21

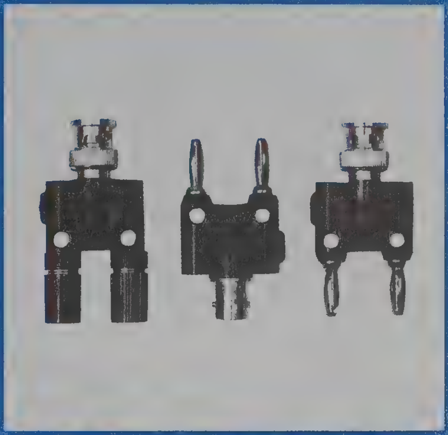
GPIB System Increases High Tech Production Test Flexibility	9498 728 00813
GPIB System Improves Metal Resistor Production Technique	9498 728 00913
GPIB System Speeds Bus Command Response Time Checking	9498 728 01013
GPIB Ensures Correct Connections in Semi-Automatic Testing	9498 728 01113
GPIB Simplifies Burn-In Testing for Multimeters	9498 728 01213
GPIB System Guarantees Long-Term Diode Performance	9498 728 01313
GPIB System Speeds Up Heat Meter Calibration	9498 728 01413
GPIB System Speeds Oscilloscope Calibration	9498 728 01513
GPIB System Speeds Calibration of Crystal Oscillators	9498 728 01613

Various

Basic Principles and Measuring Techniques of the Philips VHF Oscilloscopes	9498 720 01214
PM 8271/72 Quick Operating Card	9498 727 00519
PM 3570 Quick Operating Guide	9498 505 01511
PM 3320 Quick Operating Guide	9498 449 05911
PM 3285A/95A Quick Operating Guide	9498 720 01319
PM 3050/55 Quick Operating Card	9498 720 00819
PM 3632 Short Operating Guidd	9498 505 01311
PM 3360 in Materials Testing	9498 443 04811
PM 3360 Advanced Measurement Solutions	9498 443 05011
PM 3305 Quick Operating Guide	9498 445 04611
PM 3360 Qick Operating Guide	9498 445 04811
PM 3305 Automotive Industry	9498 445 05611
PM 3360 Quality Control in TV and Video	9498 445 05511
PM 3360 Quality Control in Electrical Engineering	9498 720 00614
PM 3360 Quality Control in Mechanical Engineering	9498 720 00714
PM 3360 in the Automotive Industry	9498 720 01414
PM 3360 for Mains Analysis	9498 720 01516
PM 2618 MAS Multimeter for Medical Applications	9498 477 01511

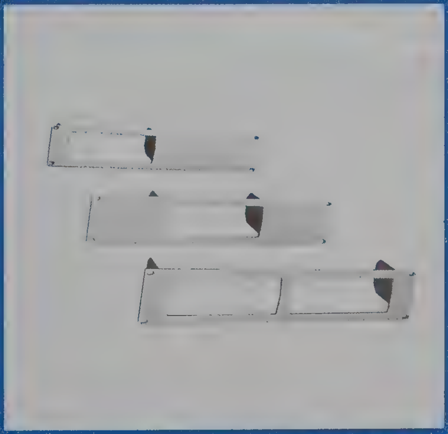
General Accessories

This section includes an assortment of general instrument accessories that are compatible with a wide variety of Fluke and Philips instruments and products. Please also refer to the individual product sections in this catalog, as well as the alphabetical index, for specifications and ordering information on other accessories designed specifically for use with particular products.



BNC-Banana Adapters

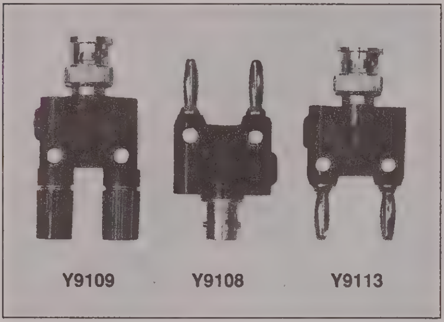
Cables



Rack Adapters

Adapters 486
Connectors 486
Cables 487
Rack Adapters 488

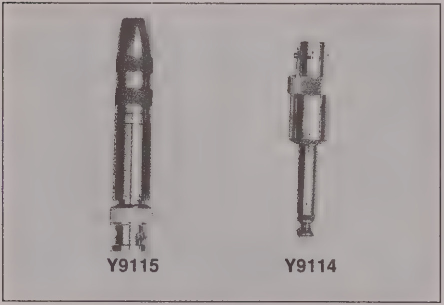
Also see page 127 for other accessories.



BNC-Banana Adapters*

BNC-to-banana adapters permit interconnection between equipment having BNC plugs or jacks and equipment with double banana plugs or jacks.

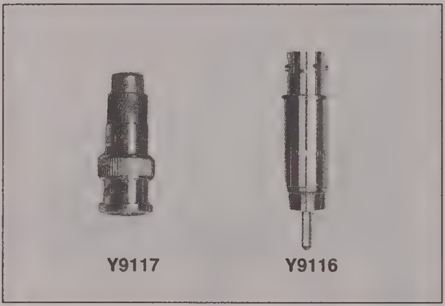
Y9108**	BNC Jack to Double Banana Plugs	$15
Y9109**	Binding Posts to BNC Plug	20
Y9113**	BNC Plug to Double Banana Plugs	20



Phone Adapters*

Adapters permit interconnection between equipment with phone plugs and equipment with BNC our double banana plug connectors.

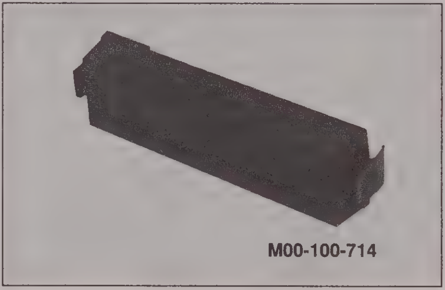
Y9114**	BNC Jack to Phone Plug	$20
Y9115**	Phone Jack to BNC Plug	20



Phono Adapters*

Adapters allow interconnection between equipment having phono connectors and BNC connectors.

Y9116**	BNC Jack to Phono Plug	$20
Y9117**	Phono Jack to BNC Plug	20

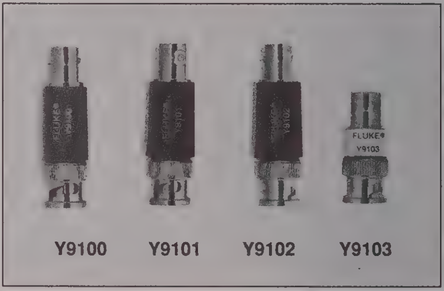


M00-100-714 Panel Protectors

A front panel protector is a molded plastic, snap-on accessory which fits over the front panel of a DMM, counter, etc. The cover provides protection for the front panel controls, and is useful for storing or transporting the instrument.

M00-100-714 is designed to fit the 8000A and 8600A DMM, and the 1900A, 1910A, 1911A, 1912A Counters. M03-203-700 is designed to fit the 515A Calibrator and the discontinued 8200A DMM.

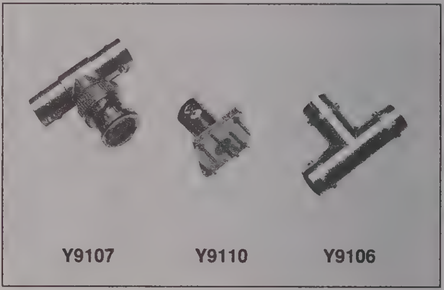
M00-100-714**	Dust Cover	$10
M03-203-700*	Dust Cover	25



BNC 50-Ohm Attenuators, etc.

BNC 50-ohm, 2-watt attenuators for use with VHF and UHF instruments:

Y9100**	6 dB Attenuator	$55
Y9101**	14 dB Attenuator	55
Y9102**	20 dB Attenuator	55
Y9103**	BNC 508 feedthru terminator	35
Y9301	Min-Loss Pad, 50Ω to 75Ω, Type N	260
Y9317	50Ω Termination, Shielded, Type N	95

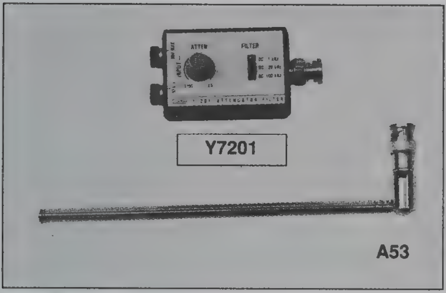


BNC Connectors

Y9107**	BNC "T" Jack, Plug, Jack	$15
Y9110**	BNC Jack to PC Pins	20
Y9106**	BNC "T" 3 Jacks	20
Y9307	Adapter, N to BNC, 75Ω	20
Y9308	Adapter, N to BNC, 50Ω	20
Y9316	Cap, Non-Shorting, BNC	10

** These adapters and exposed metal connectors should not be used for floating measurements that are greater than 30V ac, 42V peak or 60V dc above earth ground.*

***Available through Distributors*



Y7201 Attenuator/Filter

The Y7201 is a combination variable attenuator and selectable low pass filter which can be used for input signal conditioning on all Fluke counters.

Input Impedance: 47 kΩ

Attenuation Range: ÷5 to ÷100, continuously adjustable

Low Pass Filter: 1 kHz, 20 kHz, or 100 kHz switch-selectable

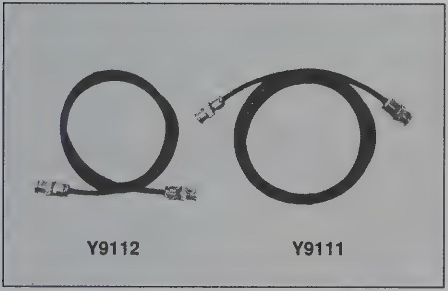
Maximum Input: 30V

Y7201** Attenuator/Filter (Counters)	$65

A53 Telescopic Whip Antenna

Telescopic Whip Antenna connects to input of all counters. Uses swivel BNC connector. Permits measurements without direct cable connections whenever input signal strength is sufficient.

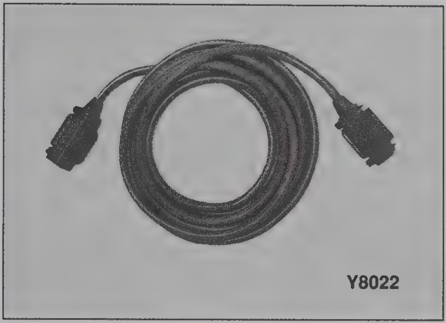
A53** Telescopic Whip Antenna	$30



50Ω BNC Coaxial Cables*

RG-58 C/U coaxial cables with BNC connectors (plugs) on each end are available in two lengths:

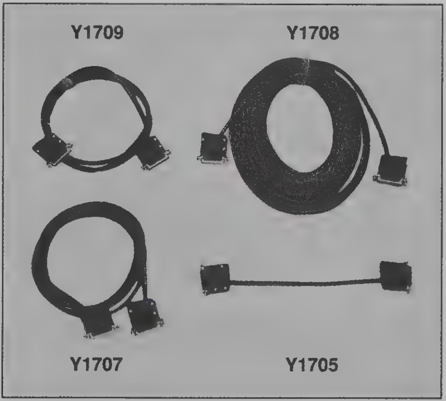
Y9111** BNC Cable 0.93m (3 ft) 50Ω	$20
Y9112** BNC Cable 1.85m (6 ft) 50Ω	20
Y9315 Coaxial Cable, N Mate	65



IEEE-488-Compatible Cables

A series of cables in three lengths are used to connect instruments to each other and to the IEEE-488 Bus. Each cable end has both a plug and a jack and are shielded.

Y8021 Shielded IEEE-488 Cable 1m (39.4")	$125
Y8022 Shielded IEEE-488 Cable 2m (78.8")	135
Y8023 Shielded IEEE-488 Cable 4m (13')	145

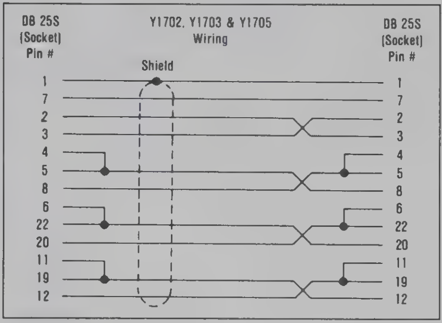


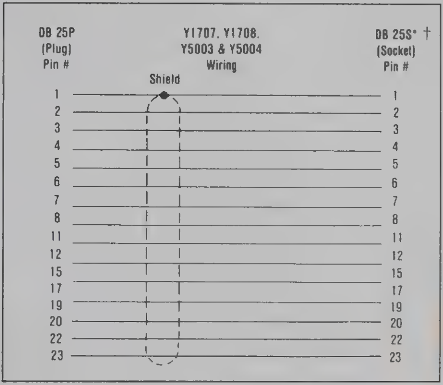
RS-232 Cables

These cables are to connect instrument controllers, terminals, modems, printers, etc. to other similar equipment compatible with EIA Standard RS-232-C.

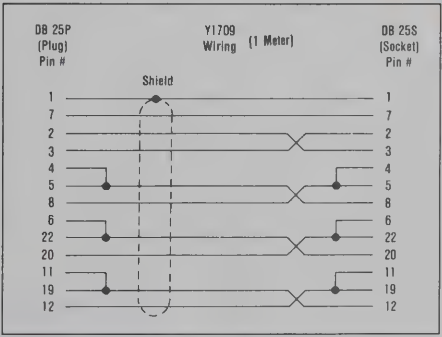
Y1702 Null Modem Cable 2m (6.56 ft)	$125
Y1703 Null Modem Cable 4m (13 ft)	150
Y1705 Null Modem Cable 30m (1 ft)	75
Y1707 Interface Cable 2m (6.56 ft)	125
Y1708 Interface Cable 10m (32.8 ft)	150
Y1709 Printer Cable 1m (3.28 ft)	125
Y5003 Interface Cable 1.52m (5 ft)	130
Y5004 Interface Cable 3.05m (10 ft)	140

RS-232 Cable Wiring





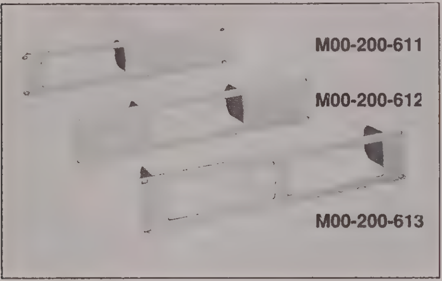
† DB 25P for Y5003 and Y5004



Rack-Width Rack Adapters

Fluke bench/systems instruments are designed to be easily mounted in a standard 19-inch rack cabinet. Some have rack-mount panels and some need rack adapters. When adapters are required they are listed with the instrument – among its recommended accessories.

Portable Instrument Rack Adapters



Multimeter Rack Adapters 3-1/2" High

8000A, 8010A, 8012A, 8050A, 8600A: M00-200-611, M00-200-612 & M00-200-613
8840A, 8842A, 8840A/AF: Y8834 and Y8835

Y8834 Single Rack Mount Kit, 8840A, 8842A	$45
Y8835 Dual Rack Mount Kit, 8840A, 8842A	100

Counter Rack Adapters 3-1/2" High

1900A, 1910A, 1911A, 1912A: M00-200-611, M00-200-612 & M00-200-613

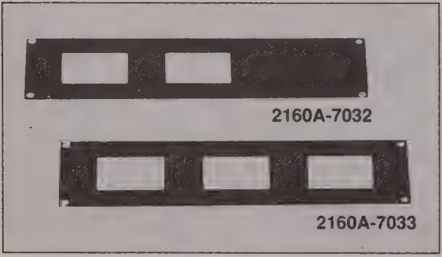
Thermometer Rack Adapters
3-1/2" High

2165A, 2166A, 2168A, 2175A, 2176A: M00-200-611, M00-200-612 & M00-200-613

M00-200-611** 3-1/2" Rack Mount Kit, Offset	$50
M00-200-612** 3-1/2" Rack Mount Kit, Center	50
M00-200-613** 3-1/2" Rack Mount Kit, Dual	60

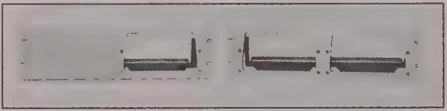
* *These adapters and exposed metal connectors should not be used for floating measurements that are greater than 30V ac, 42V peak or 60V dc above earth ground.*
** *Available through Distributors*

Panel-Mount Thermometer Adapters



Either the 2160A or the 2170A Thermometer may be mounted in these rack-width panels that are 3-1/2 inches high. Also, the 2161A Multipoint Selector and 2162A Digital Comparator will fit the panel openings.

2160A-7032** 3-1/2" Rack Mount Panel Kit, Double	$90
2160A-7033** 3-1/2" Rack Mount Panel Kit, Triple	90



PTI-Style Instrument Adapters

Rack adapters for the 2180- and 2190-Series Thermometers, 7200 Series Counters, 8920 Series DVMs, and other Fluke products in PTI cases look like those shown in the picture except for the size of the opening or height of the panel.

PTI Case Style	Panel Opening		Rack Panel Size	
	Single	Double	Height	Width
A	Y2010	Y2011	3-1/2 in (89 mm)	19 in (483 mm)
B C	Y2012 Y2014	Y2013 Y2015	5-1/4 in (133 mm)	
D	Y2016	Y2017	7 in (177.8 mm)	
A+C	–	Y2027	5-1/4 in (133 mm)	

PTI-Style Instrument Panel Adapters

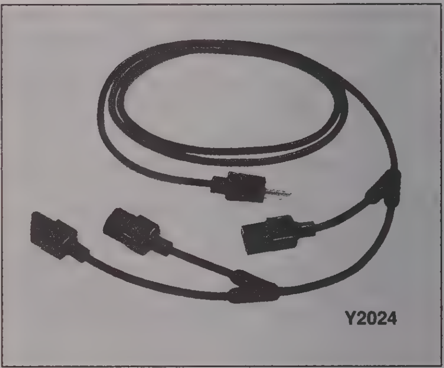
Fluke instruments in PTI-style cases may be mounted behind your own panel through a standard size panel opening by using one of the adapters identified below.

PTI Case Style	Adapt. No.	Panel-Mount Adapters			
		Panel Cutout		Bezel Size	
		Height	Width	Height	Width
A	Y2018	92 mm (3.62 in)	186 mm (7.32 in)	97 mm (3.82 in)	214 mm (8.43 in)
B	Y2019	92 mm (3.62 in)		97 mm (3.82 in)	
C	Y2020	†		122mm (4.80 in)	
D	Y2021	138 mm (5.43 in)		145 mm (5.70 in)	

† Any dimension from 96 mm to 116 mm. Not Standard. Each kit fastens to a panel with four machine screws. The bezel fits over the front of the panel cutout and the screws hold the bezel and rear (instrument) support bracket to the panel.

PTI-Style Instruments

PTI Instruments & Accessories	PTI Case Style			
	A	B	C	D
1120A			•	
2020A, 2030A, 2300A				•
2180A, 2189A, 2190			•	
Y2000, Y2001	•			
Y2002			•	
Y2003, Y2009		•		
7220A, 7250A, 7260A, 7261A			•	
8860A				•
8920A, 8921A, 8922A			•	
Y5020				•
Y2023			•	



Y2024 3-Module Power Cord

Three 3-wire receptacles for powering two or three PTI-style instruments from one power outlet.

PTI Case Dimensions

Style	Height	Width	Depth
A	57 mm (2.25 in)	205 mm (8.05 in)	326 mm (12.85 in)
B	82 mm (3.23 in)		
C	105 mm (4.13 in)		
D	128 mm (5.03 in)		

Ordering Information

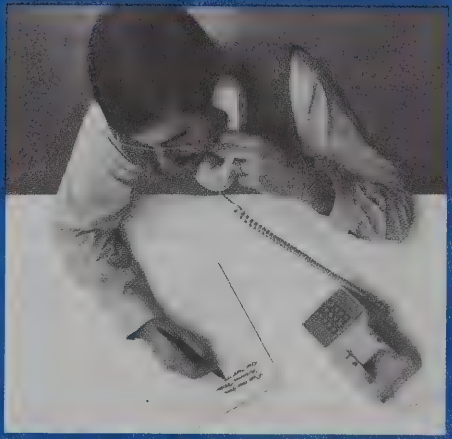
Models

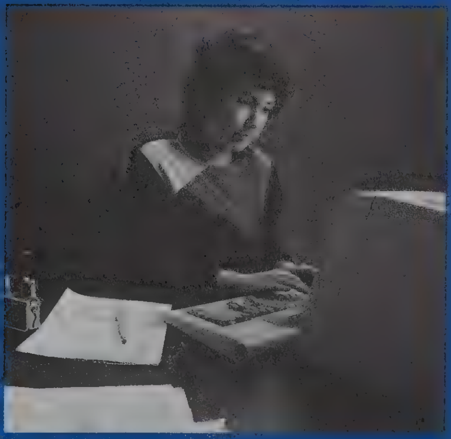
January 1989 prices

Y2010 3-1/2" Rack Mount Kit PTI, Single	$95
Y2014 5-1/4" Rack Mount Kit PTI, Single	95
Y2015 5-1/4" Rack Mount Kit PTI, Double	95
Y2016 17" Rack Mount Kit PTI, Single	95
Y2017 17" Rack Mount Kit PTI, Double	95
Y2020 4.80" DIN Panel Mount Kit PTI	95
Y2021 5.70" DIN Panel Mount Kit PTI	95
Y2024 3-Module Power Cord	21

Ordering Information

Ordering Fluke and Philips products is as easy and convenient as picking up the phone. Fluke and Philips Sales Offices, Representatives and Authorized Industrial Distributors are located worldwide to provide you with immediate sales assistance, on your local level. For U.S. Government purchases, we also have strategically located sales specialists ready to assist your needs. For details on pricing, delivery and terms, to technical information regarding the suitability of a particular product for a specific application, Fluke and Philips can help. Give us a call.





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Call Guide .... Inside Back Cover

Working With Fluke

Fluke's sales and service organization is built around one single premise: To give you, our customer, an extra measure of value in everything we do for you. The large number of convenient local Fluke sales offices, technical service centers, distributors and representatives around the world is a reflection of that commitment.

Your Local Fluke Sales Office

Your introduction to Fluke and Philips products and services is your local Fluke sales office. The majority of these offices are linked to the Fluke factory, which means you can get information you need on our products and services, fast and accurately. A complete listing of sales offices begins on page 504.

Call Your Local Fluke Sales Office for:

• Application Assistance

A Fluke sales engineer can answer your questions and help you identify the Fluke and Philips equipment that meets your application. The sales engineer is backed by application engineers and factory specialists who can help create solutions for your test, measurement and control problems.

• Product Demonstrations

Demonstrations of a particular Fluke or Philips instrument may be arranged through your local Fluke sales office. A large inventory is maintained of many Fluke and Philips instruments for demonstration purposes, and we will make every effort to accomodate your needs. Fluke and Philips products are also displayed at many trade shows throughout the year. And also look for the Fluke and Philips unique mobile electronics exhibit vans. They regularly travel throughout the U.S., visiting key customer sites. We also welcome you at the Fluke factory in Everett, Washington. Your local Fluke sales office can help arrange a factory visit, and tell you more about our trade show and van schedule.

• Custom Instruments and Systems

Many Fluke and Philips instruments can be supplied in different colors, with altered specification ranges, special connectors, or other special features. Some systems may also be assembled and customized to your requirements. Fluke also gives you access to FCS — Fluke Cooperative Services. FCS is a network of independent specialists who know hardware, software, and your industry. FCS is for project managers, production managers, systems engineers — anyone who needs total test, measurement, and control systems solutions. Call your local Fluke sales office for more information.

• Quotations

Often times it is difficult to know exactly what is needed in regards to options, accessories, and service packages for the instrumentation you need us to quote. Your local Fluke sales office can help. Each is staffed by professional sales engineers who are ready to assist you in preparing quotes on any of the products found in this catalog. Simply call or write your local Fluke sales offices for immediate quotation service. If you have any special requirements unique to your request, please be as specific as possible, so that we may be able to provide you with a quote that reflects exactly what you need.

• Placing Your Order

In many instances, the information contained within this catalog will be sufficient for you to decide on which product or service you wish to purchase. In these events, a phone call to your local Fluke Sales Office can provide you with product availability and pricing. When placing your order, please be sure to specify the product's order number (model, accessory, or part) as well as the product name. It's best to be as complete as possible. Once the order is placed, you will receive confirmation of your order, along with a scheduled ship date.

Fluke Technical Service Centers

Strategically located in major markets throughout the world, our technical service centers are equipped with the necessary instruments, standards, procedures and personnel to help you maintain Fluke and Philips products to peak performance. To order repairs, calibration services, service agreements, call the Technical Service Center nearest you. A complete listing is shown on page 497.

U.S. Government Sales & Support

Fluke's Government Operations Group can provide you with the latest information on provisioning, nomenclature, and National Stock Numbers. They can also provide ordering assistance and guidance for the many special Fluke and Philips products, systems, and services that specifically support Government applications. Most of the instruments in this catalog are available on General Service Administration Contracts. A complete listing of U.S. Government Sales and Support offices are on page 492.

The Fluke Factory

Call the Fluke Factory for:

• Replacement Parts Orders and Module Exchange

All orders for replacement parts and module exchanges can be placed by calling 1-800-526-4731, in Alaska, Hawaii and Washington call (206) 356-5774. A trained specialist for both Fluke and Philips product lines will assist you in answering price and delivery questions and will take your order.

• Export Shipments

Questions on licensing issues, shipping costs, proforma invoices, power cords, etc. can be answered by calling Fluke's export sales office at (206) 356-5112.

•Training

Any training questions at all can be answered by calling 1-800-44-FLUKE, ext 73.

• Before and After Sales Application Assistance

If your local sales engineer isn't readily available, Fluke offers a toll-free telephone service to provide immediate answers to questions you may have regarding the suitability of a product for a particular application, or operational assistance regarding the product itself. You may also call this number to find the location of your nearest Fluke Sales Office or authorized distributor. Call 1-800-44-FLUKE.

Fluke Distributors

Distributors in over 500 U.S. locations stock many Fluke products for immediate delivery. Products include such instruments as handheld/benchtop digital multimeters, thermometers, and accessories. Fluke products carried at distributor locations are footnoted in the product index pages at the beginning of this catalog. Also, there is a phrase stating "Available through Fluke Distributors" in the ordering information block for each specific product described throughout the catalog. (To purchase distributor-sold products in quantities more than 50, contact your Fluke Sales Office.)

For the Fluke Distributor located closest to you, see pages 500, 501 and page 502. Or call 1-800-44-FLUKE.

The Fluke Warranty

Fluke warrants each product it sells to be free from defects in material and workmanship under normal use and service. Software is warranted to operate in accordance with its programmed instructions on appropriate Fluke or Philips products; it is not warranted to be error free. This warranty extends only to the original purchaser and does not apply to fuses, computer media, batteries or any product which, in Fluke's sole opinion, has been subject to misuse, alteration or abnormal conditions of operation or handling. The warranty period is controlled by the warranty document furnished with each product and begins on the date of shipment. For specific warranty periods, refer to the appropriate product page in this catalog.

For warranty service, contact a Fluke Technical Center or send the product, with a description of the difficulty, postage prepaid, to the nearest Fluke Technical Center. Fluke assumes no risk for damage in transit. Fluke will, at its option, repair or replace the product free of charge. However, if Fluke determines that the failure was caused by misuse, alteration or abnormal condition of operation or handling, you will be billed for the repair. The repaired instrument will be returned to you, transportation prepaid.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE. FLUKE WILL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSS WHETHER IN CONTRACT, TORT, OR OTHERWISE.

Terms & Conditions of Sale

Prices and Terms

Prices shown in this catalog are suggested U.S. list prices prevailing at the time of printing. John Fluke Mfg. Co., Inc. reserves the right to change prices, and the prices in effect at the time an order is received will apply. Prices are F.O.B. origin unless otherwise specified, and apply only when the final destination is within the U.S.A..

U.S. terms are 30 days net. Unless credit has already been established, shipments will be made C.O.D. or on receipt of cash in advance. Terms for orders for other countries are either an irrevocable letter of credit or cash in advance, unless other terms have been previously arranged.

Shipping Methods

Unless specifically requested otherwise, surface transportation is used in the U.S., which may include motor freight or United Parcel Service. Air freight or air express will be used only if you specify it on your order. Unless buyer requests collect shipment, all shipping charges are prepaid and added to the invoice as a separate line item.

Shipments to destinations outside the U.S. are made from the appropriate Fluke or Philips facility by either surface or air, per buyers request. Please note that shipments by sea usually require commercial export packaging at a nominal extra charge.

Product Changes

Although product information and illustrations in this catalog were current at the time it was approved for printing, John Fluke Mfg. Co., Inc., in a continuing effort to offer excellent products at a fair value, reserves the right to change specifications, designs, and models without notice.

Calibration Reports

Special calibration reports are available for a modest fee that include numerical values pertaining to the calibration, the uncertainties associated with the calibration, and statements explaining the calibration. Your local Fluke Sales Office can advise you of the fee for any special calibration report you may require. They must be thoroughly defined when an order is placed.

Power Cords

Power Cords

Fluke instruments are fitted with one of the power cord and plug options shown below and are wired for the voltage indicated. The power cord supplied with your instrument is the one commonly used in the country where the instrument will be delivered.

If you require a power cord and plug other than the one listed below for the country where the instrument will be delivered, specify that power cord and plug when you order.

Philips instruments listed in this catalog are configured for standard North American power requirements. If you require a different configuration, specify power cord and plug combination from the list below.

Environmental Capabilities

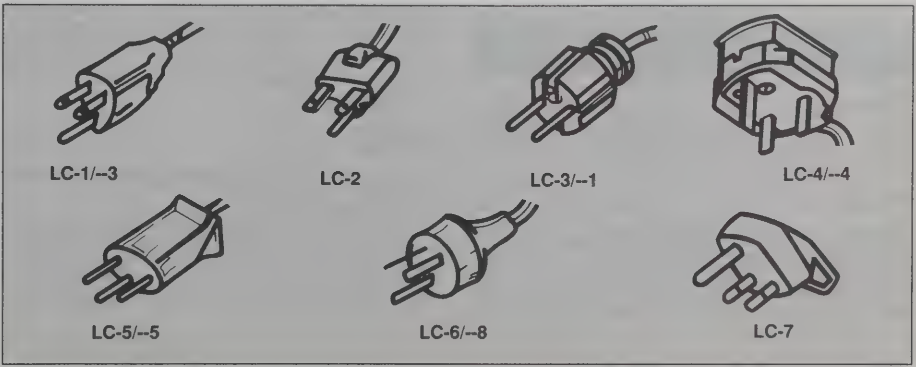
N.B.:

The environmental data is valid only if the instrument is checked in accordance with the official checking procedure. Details of these procedures and failure criteria are supplied on request by your local Fluke or Philips organization.

		Fluke	Philips	
			Product Category 1*	Product Category 2**
North America	120V/15A	Option LC-1	/--3	
North American	240V/15A	Option LC-2		
Universal Euro	220V/16A	Option LC-3	/--1	Specify Country of destination on order
United Kingdom	240V/13A	Option LC-4	/--4	
Switzerland	220V/10A	Option LC-5	/--5	
Australia	240V/10A	Option LC-6	/--8	
South African	240V/5A	Option LC-7	Ask for LC-7	

**Final digit in model number format PM ----/--- for Philips Category 1 Products including Oscilloscopes (except as in 2 below), Multimeters, Recorders, and System 21*

***Philips Category 2 Products including Logic Analyzers, Signal Sources, Pulse Generators, Pattern Generators, Counters and Scope models PM 3219/3264/3266/3267*



Ordering Information

Government Operations Group

Fluke sales offices (see page 504) and the Government Operations offices listed here have the latest information on provisioning, nomenclature, and National Stock Numbers.

National Office
Defense and Government
Operations Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Air Force Offices
Air Force Manager
10417 Gulfdale
San Antonio, TX 78216
(512) 340-2621

5450 Far Hills Avenue
Suite 111
Kettering, OH 45429
(513) 436-2224

Navy Offices
Navy Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

16969 Von Karman Ave.
Suite 100
Irvine, CA 92714
(714) 863-9031

Army Office
Army Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

4920 Corporate Drive
Suite J
Huntsville, AL 35805-6202
(205) 837-0581

Marine Corp Office
Marine Corp Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Dept. of Transportation
(FAA/U.S. Coast Guard)
Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Security Agencies Office
Security Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

U.S. General Services Administration

Most of the instruments in this catalog are available on the following General Services Administration Contracts in FSC Group 66, Part II, Sections "H" and "J", Class 6625:

Contract	Period	Category
GS00F03546 (Section H)	Sept 12, 1988 to July 31, 1991	Electrical/ Electronic Components & Test Equipment
GS00F93525 (Section J)	Sept 28, 1987 to May 31, 1990	Instruments: Measuring and Testing

Special Products, Systems & Services

Listed below are examples of products, systems, and services that specifically support Government applications.

Products

Model 6060A/AN Synthesized Signal Generator. (NSN 6625-01-222-5007). A low-cost efficient signal generator and FM deviation meter with a frequency range of 10 kHz to 520 MHz.

Model 8520A/AS-1 System Multimeter (NSN 6625-01-141-8057). Certified by the Air Force as the first module to complete all requirements imposed by the Modular Automated Test Equipment (MATE) Program.

Model 8025B Multimeter (NSN 6625-01-266-3494). A feature loaded handheld multimeter designed to the rugged requirements of MIL-T-28800 Type II, Class 2, Style A. Basic dc accuracy is 0.1% and includes a 31-segment bargraph for peaking, nulling and capacitor checking, "Touch Hold" to capture and display readings. Operates over the rugged temperature range of -40 to 55°C and comes with a ruggedized hard case and low temperature test leads.

Model 27/FM Multimeter (AN/PSM-45A NSN 6625-01-265-6000). A 3-1/2 digit multimeter with 80K-6 High Voltage Probe selected by the Army as the preferred portable multimeter for multiservice maintenance and repair testing.

Model 8840A/AF Digital Multimeter (NSN 6625-01-196-0014). A low-cost, high-accuracy 5-1/2 digit multimeter for bench and system applications.

9010A/AF Microprocessor Board Test-Set. A bench top "Troubleshooter" for the repair of Microprocessor based equipment and instruments. The Test Set consists of a 9XXXA Digital-System mainframe with a compliment of Test Interface Pods. Selected for use in Calibration and Repair facilities.

Systems

MECCA (Modularly Equipped and Configured Calibrators and Analyzers). Provides the Navy with automatic calibration capability onsite under rigorous conditions by integrating the Fluke 1722A/AP Instrument Controller, 5102B Meter Calibrator and 8506A/AN Digital Multimeter.

Model A123 Automated Calibration System. A high accuracy mobile calibration system, configured to calibrate 5-1/2 and 6-1/2 digit DMMs automatically.

Software

FlexSys (ATLAS Test Software). FlexSys is a complete ATLAS software system which runs on Fluke's powerful IEEE-488 Controller, the 1722A. With FlexSys and the use of resource descriptions, TPS integration is rapid and easy. ATE system reconfiguration can be accomplished without recompiling or modifying ATLAS test procedures.

Services

Direct Voltage Maintenance Program. (See page 231.)

Application Training. Some of the courses presently available, including several which are complimentary with a system purchase, are identified below. Contact your local Fluke sales office or Government Operations field office for the most current information on course/seminar content and attendance considerations. (See page 476.)

1722/1752 Data Acquisition Training Course
2280 Data Loggers Training Course
2452MCS Measurement and Control System
  Training Course
3040A-1 Digital/Analog Board Test System
  Training Course
3050B Digital/Analog Board Test System
  Training Course
3200A Manufacturing Defect Analyzer
  Training Course
6070A/6071A Signal Generator RF Seminar
7405A/7410A-100 Automated Calibration
  System Intermediate Training
9000A Micro-System Troubleshooter
  Introductory Training
  (Basic and Advanced courses)
9100A Programming Courses
Principles of Metrology

Maintenance Training. Fluke understands the needs of customers who want their own maintenance capability, especially the Military. Maintenance training courses currently scheduled for presentation at various Technical Service Centers include: (See page 476 for complete course listing and contact locations.)

1722 Instrument Controller
2280 Data Logger
2452 Intelligent Computer Front End
3040 PCB Test System
3050 PCB Functional Test System
3200 Manufacturing Defects Analyzer
5100/5101/5102 Meter Calibrator
5200 Programmable AC Calibrator
8500/8502/8505/8506 Digital Multimeters
8840 Digital Multimeters
Digital Multimeters (Bench & Handheld models)

Logistics Data Book

The Fluke Government Operations Group has prepared a Logistics Data Book, containing information to aid in ordering Fluke and Philips instruments. The available Fluke and Philips instruments are listed by National Stock Number and cross referenced. Many services available through our Customer Support Group are listed, including replacement spare parts kits, application and maintenance training, and special applications support. To obtain a copy of the Logistics Data Book, please contact the nearest Fluke sales office.

National Stock Numbers

To obtain current NSNs for Fluke and Philips products, turn to the specific product page, the NSNs are printed within the instrument photo. Updated NSN listings are available through the nearest Fluke Government Operations Office or the Logistics Data Book.

Algeria

Bureau de Liaison Philips
(For Fluke and Philips products)
24 rue Bougainville
El Mouradis, Alger
Tel: 60 14 05
TLX: 62221

Antilles

Philips Antillana N.V.
(For Philips products)
Schottegatweg Oost 146
P.O. Box 3523
Willemstad, Curacao
Tel: 599-9-615277
TLX: 1047

Argentina

Coasin S.A.
(For Fluke products)
Virrey del Pino 4071DPTO E-65
1430 CAP FED
Buenos Aires, Argentina
Tel: (54) (1) 552-5248
TLX: (390) 22284

Philips Argentina S.A.
(For Philips products)
Casilla Correo 3479
Vedia 3892
1430 Buenos Aires
Tel: 54-1-5414106/5417141
TLX: 21359/21243

Australia

Philips Scientific & Industrial Pty Ltd.
(For Fluke and Philips products)
Centrecourt 25-27 Paul Street
North Ryde
Sydney N.S.W. 2113
Tel: (61) 88 88 222
FAX: (61) 2-888-0440

Austria

Osterreichische Philips Industrie GmbH
(For Fluke and Philips products)
Geschaftsbereich I & E
Marktbereich Test-und MeBgerate
A-1101 WIEN, Triester StraBe 64
Tel: (0222) 60101/1722 DW

Bangladesh

Motherland Corporation
(For Fluke products)
24 Hatkhola Road, Tikatuli
Dacca-3, Bangledesh
Tel: 257249
TLX: (950) 642022

Philips Bangladesh Ltd.
(For Philips products)
P.O. Box 62, Ramna
16/17 Kawran Bazar C/A
DHAKA
Tel: 411976
TLX: 65668

Belgium

N.V. Philips Professional Systems S.A.
Test and Measurement
(For Fluke and Philips products)
Tweestationsstraat 80
Rue des Deux Gares
Brussel 1070 Bruxelles
Tel: 2-5256111

Bolivia

Coasin Bolivia S.R.L.
(For Fluke products)
Casilla 7295
La Paz, Bolivia
Tel: (591) (2) 40962
TLX: (336) 3233 COALAP BV

Brazil

ATP Hi-Tek Eletronica Ltda.
(For Fluke products)
Al. Amazonas 422, Alphaville
Barueri 06400
Sao Paulo, Brazil
Tel: (55) (11) 421-5477
TLX: (391) 1171413

Philips do Brasil Ltda.
(For Philips products)
Av. Eng. Luiz Carlos Berrini 3009
Caixa Postal 8681
04571 SAO PAULO S.P.
Tel: 55-11-2411611
TLX: (011) 32750

Brunei

Rank O'Connor's, Sdn Bhd
(For Fluke products)
No. 8 Block D,
Sufri Shophouse Complex
Mile 1 Jalan Tutong
Bandar Seri Begawan
Negara Brunei Darussalam
Tel: (673) (2) 23109 or 23557
TLX: (799) BU2265 RANKOC

Canada

Fluke Electronics Canada Inc.
(For Fluke and Philips products)
400 Britannia Rd. East Unit #1
Mississauga, Ontario
L4Z 1X9 Canada
Tel: (416) 890-7600
FAX: (416) 890-6866

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(For Philips products)
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(For Philips products)
Mwembeshi Road
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Lusaka, Zambia
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(For Philips products)
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62 Mutare Rd
Harare, Zimbabwe
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(803) 779-5332 DIX
(803) 256-0746 WIE
Greenville
(803) 297-1430 DIX
(803) 233-4121 EMS
North Charleston
(803) 554-7515 DIX

South Dakota

See Minnesota or
North Dakota

Tennessee

Gray
(615) 247-7125 DIX
Knoxville
(615) 966-3441 BRO
Memphis
(901) 365-3539 CAB
(901) 345-9500 BLU
(901) 795-8487 BRO
Nashville
(615) 242-8000 BLU
(615) 885-1302 BRO

Texas

Austin
(512) 837-5555 NEI
Beaumont
(409) 833-9443 RAL
(409) 838-0393 RAW
Corpus Christi
(512) 887-0001 RAW
Dallas
(214) 631-3600 BRW
(214) 343-8800 BUT
(214) 243-7000 INO
(214) 233-0020 NEI
(214) 969-9400 WES
El Paso
(915) 778-4448 GIS
(915) 533-9555 MID
Fort Worth
(817) 336-5401 ALE
Freeport
(409) 233-5451 BRW
Garland
(214) 271-5671 CRM
(214) 348-8800 TUK
Houston
(713) 526-3456 ETX
(713) 688-7000 INO
(713) 644-1631 MTI
(713) 777-1666 NEI
(713) 694-2771 BRO
(713) 688-8126 RAW
(713) 955-0595 SPE
Irving
(214) 550-1923 SPE
(214) 659-0930 VWR
Longview
(214) 753-0919 IES
Midland
(915) 694-9657 ESI
Port Lavaca
(512) 552-7525 RAW
Richardson
(214) 234-3392 USI
San Antonio
(512) 491-9460 RAW
Texarkana
(214) 792-6923 CAB
Texas City
(409) 948-3446 RAW
Wichita Falls
(817) 723-8106 WES

Utah

Salt Lake City
(801) 261-8877 EIL
(801) 486-3371 SSC

Vermont

See Massachusetts or
New York

Virginia

Arlington
(703) 524-2412 ARL
Bluefield
(304) 487-1477 BRO
(703) 322-3402 BRO
Norfolk
(804) 855-2400 BRO
(804) 499-3746 EIL
(804) 855-0105 PEL
Richmond
(804) 275-1431 MEM
Springfield
(703) 569-2611 EIL

West Virginia

See Ohio,
Pennsylvania, Maryland
or Virginia

Washington

Redmond
(206) 882-3222 EIL
(206) 823-4111 VAN
Richland
(509) 943-8336 RAD
Seattle
(206) 547-2827 ALE
(206) 762-6050 BIC
(206) 282-2511 RAD
Spokane
(509) 747-3053 RAD

Wisconsin

Green Bay
(414) 435-8331 NRT
Milwaukee
(414) 475-6000 MES
Oshkosh
(414) 235-8930 ELI

Wyoming

See Colorado,
Nebraska, or Utah

ACO	ACRO Electronics, Corp.
ALA	Alaska Electronics Supply
ALE	Allied Electronics
ARL	Arlington Electronic
ASC	Ames Supply Co
ATR	Atrix Tool
BEL	Bell Industries
BIC	Branom Instrument Co.
BJW	B.J. Wolfe
BLU	Bluff City Electronics
BNC	B & C Instruments
BOM	Bomar Electronics
BON	Bonnin Electronics
BRG	Breard-Gardner
BRI	Brill Electronics Products
BRO	Brownell Electro
BRW	Briggs-Weaver
BUT	Butler & Land
CAB	Carlton-Bates
CAL	Calcotron
CAP	Capital Radio
CEI	Contact East Inc.
CMK	Com Kyl
COD	Concord Electronics
COL	Col. Spgs. Wintronic Co.
COM	Commodore I
COR	Corning Electronics
CRM	Crompton Metermaster, Inc.
CSS	California Switch & Signal
CUM	Cumberland Electronics Inc.
CWE	CW Electronic Sales
DAL	Dalis Electronics
DIX	Dixie Electronics
DOL	Dolphin Electronic Supply
EET	E.E. Taylor
EIL	EIL Instruments
ELE	Electrical Equipment Co. Ltd.
ELI	Electronic Industries, Inc.
ELT	Electra-Test
EMS	EMSCO Div. Hammond
EPC	Electronic Parts Co.
ESU	Electronic Supply
ETC	Electronic Tool Co
ETC	Electrotex
GIS	Garrett Industrial Supply
GEO	George Oliver Co.
GOE	Gopher Electronics
HAT	Hatry Electronics
HHS	Herman H. Sticht
HLD	H.L. Dalis, Inc.
HON	Honolulu Electronics
HUG	Hughes-Peters
HUR	Hurley Electronics
IDA	Idaho Instruments
IES	Industrial Electronic Supply
IIW	Industrial Instrument Works
INM	Instrument Mart
INO	INOTEK
INS	Instrumentation Services
ISI	ISI Services, Inc.
ISL	Industrial Service Labs
ITC	ITC Electronics
JAB	Jabbour Electronic Supply
JON	Jones Electronics
JOS	Joseph Electronics
KAS	KASS Electronics Dist.
KAU	Kaufman Co.
KEL	Kelvin Electronics
KIE	Kiesub Corporation
KLA	Klaus Radio
LEF	Leff Electronics
MAE	Masline Electronics Inc.
MAR	Marshall Industries
MEM	Metermetrics
MES	Marsh Electronics
MEU	Meunier Electronic Sply, Inc.
MIA	Mid-West Associated
MID	Midland Winntronics
MIT	Mitchell Instruments Co.
MTI	Meters & Instruments
NEI	Norvell Electronics
NIL	Nilsson Electrical Lab
NOR	North Supply
NRT	Northern Radio & TV
PEL	Priest Electronics
PIC	Pacific Indicator Co.
PIN	Pioneer-Standard
PMC	Process Measurement Co.
PRL	Peerless Elect. Equip
QUE	Quement Electronics
RAD	Radar Electric
RAG	Rag Electronics
RAL	Ralph's Electronics
RAW	Rawson & Co.
REM	REM Electronics
ROM	Rome Electronics
ROU	Route Electronics
RRI	R&R Instrumentation
RSE	RS Electronics
SAS	S&S Electronics
SCO	Scott Electronics
SEE	Southeastern Elect.
SHD	Shand Electronics
SHR	Shelley-Ragon
SPD	Specialty Distributing
SPE	Specialized Products
SSC	Standard Supply Co.
STA	Stark Electronic Supply
STS	Scottsdale Tool & Supply
SUN	Sunshine Scientific
TAF	Taft Electronics
TEI	Techmart Inc.
THA	ThermX of California
THX	ThermX Southwest
TKS	Tool Kit Specialists
TMT	Time Motion Tools, Inc.
TOO	Tool Tronics
TRA	Transcat
TRE	Tech. Representations
TRI	Tri-State Inst. Lab
TST	Test Equipment Service, Inc.
TTE	Technical Training Aids
TTI	Techni-Tool, Inc.
TUK	Tucker Electronics, Co.
USI	U.S. Instrument Rentals
VAN	Vanguard Electronic Tool
VWR	VWR Scientific
WAL	Walker & Associates
WAS	WASSCO
WBA	W.B. Allen Supply
WES	Wholesale Elec. Supply
WHO	Wholesale Electronics
WIE	Wholesale Ind. Elec.
WIS	Wise Components
WSJ	WS Jenks
WYL	Wyle Lab Mkt. Group
ZAC	Zack Electronics

Continental Resources, Inc.

Nationwide Toll Free	**(800) 343-4688**
Carson, CA	(213) 638-0454
San Francisco, CA	(408) 263-1775
Orlando, FL	(407) 855-9544
Bensenville, IL	(312) 860-5991
Bedford, MA	(617) 275-0850
Gaithersburg, MD	(301) 948-4310
Somerset, NJ	(201) 654-6900
Dallas, TX	(214) 458-7616

Electro Rent Corp.

Nationwide Toll Free Number	**(800) 423-2337** (Except California)
Alabama	(800) 241-9156
Alaska	(415) 964-5500
Arizona	(800) 423-2337
Arkansas	(800) 553-RENT
California Burbank	(818) 843-3131
Mountain View	(415) 964-5500
San Diego	(619) 571-7905
Southern CA	(800) 232-2173
Northern & Central CA	(800) 421-4848
Canada	(800) 268-0216
Colorado	(800) 227-8010
Connecticut	(800) 225-0836
Delaware	(800) 638-1783
District of Columbia	(301) 982-1450
Florida	(800) 241-9156
Georgia	(404) 925-9199
Hawaii	(800) 423-2337
Idaho	(800) 227-8010
Illinois	(312) 956-8350
Indiana Southern	(800) 521-5788
Northern	(800) 323-8893
Iowa	(800) 323-8893
Kansas	(800) 323-8893
Kentucky	(800) 521-5788
Louisiana	(800) 553-RENT
Maine	(800) 225-0836
Maryland	(301) 995-6707
Massachusetts	(508) 657-8400
Michigan	(313) 522-8555
Minnesota	(800) 323-8893
Mississippi	(800) 241-9156
Missouri	(800) 323-8893
Montana	(800) 227-8010
Nebraska	(800) 323-8893
Nevada	(800) 232-2173
New Hampshire	(800) 225-0836
New Jersey	(201) 857-2280
New Mexico	(800) 232-2173
New York	(800) 631-4278
North Carolina	(800) 638-1783
North Dakota	(800) 323-8893
Ohio	(800) 521-5788
Oklahoma	(800) 553-RENT
Oregon	(800) 227-8010
Pennsylvania Western	(800) 521-5788
Eastern	(800) 631-4278
Rhode Island	(800) 225-0836
South Carolina	(800) 241-9156
South Dakota	(800) 323-8893
Tennessee	(800) 241-9156
Texas	(214) 437-3383 (800) 442-1144
Utah	(800) 227-8010
Vermont	(800) 225-0836
Virginia	(800) 638-1783
Washington	(800) 227-8010
West Virginia	(800) 638-1783
Wisconsin	(800) 323-8893
Wyoming	(800) 227-8010

G.E. Quick Rentals

Compton, CA	(800) GE-RENTS (213) 605-1290
Norcross, GA	(404) 662-1338
Hammond, IN	(312) 780-0300
Schenectady, NY	(518) 385-5316

Genstar Rental Electronics, Inc.

Palo Alto, CA	(415) 856-7600 (800) 225-2422
Woodland Hills, CA	(818) 887-4000 (800) 331-3440 (800) 227-8409
Orlando, FL	(407) 859-0322 (800) 432-0612 (800) 327-0302
Gaithersburg, MD	(301) 621-4043 (800) 638-4040
Mahwah, NJ	(201) 934-0400 (800) 631-8960 (800) 562-3714
Carrollion, TX	(214) 931-8770 (800) 492-9021 (800) 323-8964
Canada, Ontario	(416) 675-7513 (800) 268-4939
Quebec	(514) 337-5775 (800) 367-5447

Leasametric

Nationwide Toll Free Number	**(800) 553-2255**
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Arizona	(800) 521-4312
Arkansas	(800) 255-9568
California Foster City	(415) 574-5797
Anaheim	(714) 634-5925
Los Angeles	(213) 671-0461 (818) 708-7334 (800) 824-4299
San Diego	(619) 565-7475
Colorado	(800) 255-9568
Connecticut	(800) 553-2255
Delaware	(800) 553-2255
Florida	(800) 638-9224
Georgia	(800) 638-9245
Hawaii	(Call Collect) (415) 574-5797
Idaho	(800) 521-4312
Illinois	(800) 553-2255
Indiana	(800) 553-2255
Iowa	(800) 255-9568
Kansas	(800) 255-9568
Kentucky	(800) 638-9245
Louisiana	(800) 255-9568
Maine	(800) 553-2255
Maryland	(301) 948-9700
Massachusetts	(800) 553-2255
Michigan	(800) 553-2255
Minnesota	(800) 255-9568
Mississippi	(800) 255-9568
Missouri	(800) 255-9568
Montana	(Call Collect) (714) 634-9525
Nebraska	(800) 255-9568
Nevada Northern	(415) 574-5797
Southern	(800) 521-4312
New Hampshire	(800) 553-2255
New Jersey	(800) 553-2255
New Mexico	(800) 255-9568
New York	(800) 553-2255
North Carolina	(800) 638-9245
North Dakota	(800) 255-9568
Ohio	(800) 553-2255
Oklahoma	(800) 255-9568
Oregon	(800) 343-7368
Pennsylvania	(800) 441-7568
Rhode Island	(800) 553-2255
South Carolina	(800) 638-9245
South Dakota	(800) 255-9568
Tennessee	(800) 638-9245
Texas Dallas	(214) 881-0279
Houston	(800) 392-3754
Utah	(800) 521-4312
Vermont	(800) 553-2255
Virginia	(800) 638-9245
Washington	(800) 343-7368
Washington, D.C.	(301) 948-9700
West Virginia	(800) 638-9245
Wisconsin Northwestern	(800) 255-9568
Southeastern	(800) 553-2255
Wyoming	(800) 521-4312

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Nationwide Toll Free Number	**(800) T-E-L-O-G-Y-I** **(800) 835-6494**
Phoenix, AZ	(602) 843-6631
Los Angeles, CA	(213) 821-4473
Oakland, CA	(415) 256-0792
Redwood City, CA	(415) 594-1700
San Diego, CA	(619) 722-5331
San Jose, CA	(800) 835-6494
Denver, CO	(303) 320-0265
Atlanta, GA	(404) 381-5169
Chicago, IL	(312) 358-4114
Boston, MA	(800) 835-6494
Annapolis, MD	(301) 827-7696
Columbia, MD	(301) 997-0382
Detroit, MI	(313) 528-0346
Newark, NJ	(201) 583-0053
Nassau County, NY	(516) 434-8840
Tulsa, OK	(918) 665-8899
Philadelphia, PA	(215) 398-1886
Houston, TX	(713) 376-8666
Richardson, TX	(214) 470-9093
McLean, VA	(703) 830-6563
Seattle, WA	(206) 451-8594

Test Equipment Corp

Mountain View, CA	(415) 964-3923 (800) 227-1995

U.S. Instrument Rentals

San Mateo, CA Nationwide:	(800) 123-USIR, ext. 930 OR (800) 242-8747, ext. 930
Alabama	(800) 638-4052
Arizona	(800) 525-7578
Arkansas	(800) 527-4262
California Burbank	(213) 849-5861
Mountain View	(415) 964-9664
San Diego	(619) 231-3990
San Mateo	(415) 579-0911
Santa Ana	(714) 641-9101
Ventura County	(805) 648-6200
Colorado Denver	(303) 790-0523
Connecticut	(800) 526-7563
Delaware	(800) 638-4059
Florida	(800) 638-4052
Georgia	(800) 638-4052
Idaho Northern	(800) 227-5075
Southern	(800) 525-7578
Illinois	(312) 991-9770
Indiana	(800) 323-6688
Kansas	(800) 323-6688
Kentucky	(800) 323-6688
Louisiana	(800) 527-4262
Maine	(800) 526-7563
Maryland	(800) 492-8747
Massachusetts	(800) 526-7563
Michigan	(800) 323-6688
Minnesota	(800) 323-6688
Mississippi	(800) 638-4052
Missouri	(800) 323-6688
Montana	(800) 525-7578
Nevada	(800) 227-5075
New Hampshire	(800) 526-7563
New Jersey Northern	(201) 494-1500
Southern	(800) 638-4059
New Mexico	(800) 525-7578
New York	(800) 631-5321
North Carolina	(800) 638-4059
North Dakota	(800) 323-6688
Ohio	(800) 323-6688
Oklahoma	(800) 527-4262
Oregon	(800) 227-5075
Pennsylvania Philadelphia	(800) 638-4059
Pittsburgh	(800) 323-6688
Rhode Island	(800) 526-7563
South Carolina	(800) 638-4059
South Dakota	(800) 323-6688
Tennessee	(800) 638-4052
Texas	(800) 442-4518
Utah	(800) 525-7578
Vermont	(800) 526-7563
Virginia	(800) 638-4059
Washington	(800) 227-5075
West Virginia	(800) 323-6688
Wisconsin	(800) 323-6688
Wyoming	(800) 525-7578

U.S. Fluke Sales Office Areas

Alabama

Huntsville
4920 Corporate Drive
Suite J
Huntsville, AL 35805-6202
(205) 837-0581

Arizona

Tempe
2211 S. 48th Street
Suite B
Tempe, AZ 85282
(602) 438-8314

Tucson
(602) 790-9881

California

Northern
46610 Landing Parkway
Fremont, CA 94538
(415) 651-5112

Irvine
P.O. Box 19676
Irvine, CA 92713-9676
16969 Von Karman
Suite 100
Irvine, CA 92714
(714) 863-9031

Burbank
(213) 849-7181

Los Angeles
(213) 747-5935

San Diego
(619) 292-7657

Colorado

Denver
14180 E. Evans Ave.
Aurora, CO 80014
(303) 695-1000

Connecticut

Hartford
Glen Lochen East
41-C New London Turnpike
Glastonbury, CT 06033
(203) 659-3541

Florida

Clearwater
(813) 799-0087

Miami
(305) 462-1380

Orlando
940 N. Fern Creek Ave.
Orlando, FL 32803
(407) 896-4881

Tampa
(813) 251-9211

Georgia

Atlanta
2700 Delk Road
Suite 150
Marietta, GA 30067
(404) 953-4747

Illinois

Chicago
1150 W. Euclid Avenue
Palatine, IL 60067
(312) 705-0500

Indiana

Indianapolis
8777 Purdue Road
Suite 101
Indianapolis, IN 46268
(317) 875-7870

Louisiana

New Orleans
(504) 455-0814

Massachusetts

Boston
Middlesex Technology Center
900 Middlesex Turnpike
Building 8
Billerica, MA 01821
(508) 663-2400

Maryland

Baltimore
(301) 792-7060

Rockville
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Michigan

Detroit
45550 Helm Street
Metro West Industrial Park
Plymouth, MI 48170
(313) 522-9140

Minnesota

Eagen
1380 Corporate Center Curve
Suite 113
Eagan, MN 55121
(612) 854-5526

Missouri

St. Louis
11756 Borman Drive
Suite 160
St. Louis, MO 63146
(314) 993-3805

North Carolina

Greensboro
1310 Beaman Place
Greensboro, NC 27408
(919) 273-1918

New Jersey

Paramus
P.O. Box 930
Paramus, NJ 07653-0930
West 75 Century Road
Paramus, NJ 07652
(201) 262-9550

New Mexico

Albuquerque
(505) 881-3550

New York

Rochester
4515 Culver Road
Rochester, NY 14622
(716) 323-1400

Ohio

Cleveland
Plaza South Three
Suite 402
7271 Engle Road
Middleburg Heights, OH
44130
(216) 234-4540

Oklahoma

Northeast
(405) 236-2977

Tulsa
(918) 665-3530

Oregon

Portland
(503) 227-2042

Pennsylvania

Malvern
200 Lindenwood Drive
Malvern, PA 19355
(215) 647-9550

Pittsburgh
(412) 261-5171

Texas

Austin
(512) 459-3344

Dallas
1801 Royal Lane
Suite 307
Dallas, TX 75229
(214) 869-0311

El Paso
(915) 533-3508

Houston
(713) 240-5995

San Antonio
10417 Gulfdale
San Antonio, TX 78216
(512) 340-0498

Utah

Salt Lake City
(801) 268-9331

Washington

Seattle
5020 148th Ave. N.E.
Suite 110
Redmond, WA 98052
(206) 881-6966

Washington, DC

Washington, DC
(301) 770-1570

Information Needed	U.S.	International
• Getting Quotes & Ordering • Product Availability • Product Demonstrations • Product Evaluations • Installation • Custom Instruments & Systems • Shipping	Your Fluke Sales Office (See page 504)	Your Fluke or Philips Sales Office or Representative (See page 493)
• Product Information • Application Assistance • Warranty Terms & Conditions	Your Fluke Sales Office OR. . .if rush information is needed 800-44-FLUKE	Your Fluke or Philips Sales Office or Representative (See page 493)
• Fluke Distributor Locations	800-44-FLUKE	Your Fluke or Philips Sales Office or Representative (See page 493)
• Repair & Calibration Services • Service Agreements	Your Fluke Technical Service Center (See page 497)	Your Fluke or Philips Service Organization (See page 497)
• Maintenance Training • Application Training	800-44-FLUKE, ext. 73	Your Fluke or Philips Sales Office or Representative (See page 493)
• Replacement Parts • Module Exchange • Operator Manuals	The Fluke Factory 800-526-4731 (in WA, AK, HI 206-356-5774)	Your Fluke or Philips Service Organization (See page 497)
• Export Orders	The Fluke Factory 206-356-5512	Your Fluke or Philips Sales Office or Representative (See page 493)
• Instrument Rentals	Rental Company Locations (See page 503)	Your Fluke or Philips Sales Office or Representative (See page 493)

John Fluke Mfg. Co., Inc.
P.O. Box C9090, Everett, WA 98206
Tel. (206) 347-6100
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(800) 443-5853 (toll free) in the U.S.A.
(416) 890-7600 from Canada
(206) 356-5500 from other countries

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FLUKE

FLUKE AND PHILIPS – THE GLOBAL ALLIANCE IN TEST & MEASUREMENT

FLUKE **PHILIPS**

- Oscilloscopes
- Multimeters & Voltmeters
- Logic Analyzers
- Board Testers & Troubleshooters
- Calibrators & Standards
- Signal Sources
- Counters/Timers
- Instrumentation Systems
- Data Acquisition
- Operator Interfaces
- Digital Thermometers
- Recorders & Plotters
- Software
- Instrument Accessories
- Customer Support Services

Test & Measurement Catalog

1989

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How to use this catalog

The section numbers listed in the above table of contents outline the broad product groupings you will find in this catalog. You can reference each of these sections by simply thumbing to the appropriate number shown on the outer margin of each product page.

When looking for a specific product or type of product within each product section, first refer to the divider page for the section.

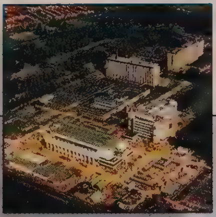
Here you will find a handy table of contents, along with pictures of several key products featured in that section. Directly following most divider pages is a selection guide that compares key features and specifications of all products in the section, and lists page numbers.

The front of the catalog also includes three master-reference page indexes.

One is an alphabetized functional listing of all products and services in the catalog, the other two are numerical listings for both the Fluke and Philips product lines.

When you have found the product you want, you may request more information by filling out and returning the enclosed reply card, or by directly contacting your nearest Fluke or Philips office as listed in the last section of this catalog.

Fluke World Headquarters Everett, Washington, USA.



Philips Research Laboratories, Eindhoven, the Netherlands.

THE GLOBAL ALLIANCE: THE NEW WORLD OF TEST AND MEASUREMENT

The Fluke and Philips test and measurement alliance is now one year old, and customers around the world are already experiencing the benefits of this unique cooperation. This catalog reflects our newly expanded product and service offerings. It includes complete specifications and performance characteristics of the entire Fluke and Philips line – over 650 products and services in all. Several new product offerings are featured for 1989, and a full-color overview of each appears in the following pages of this section.

Our Alliance -- Your Benefits

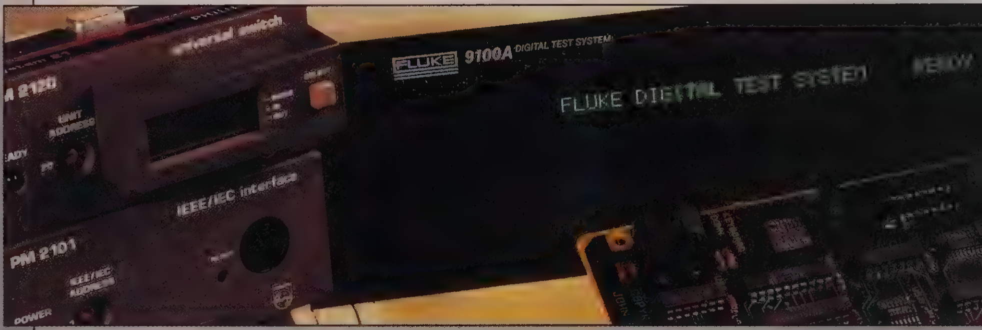
A corporate commitment to engineering excellence and a sizable investment in R&D by both Fluke and Philips allow us to design advanced technology into our products. For example, more and more of our products now exploit the increasing power of the PC, giving you more performance and efficiency from your test instrumentation. We have also expanded our product line to include support for the latest types of microprocessor-based circuitry, including the 80386. And a new generation of key product families combine the performance and functions of several instruments for easier, faster, and more capable testing of today's complex electronics circuitry.

But the Fluke and Philips alliance is more than just products. It is a strict obligation to your complete satisfaction, evidenced by the people, parts, and facilities dedicated to serving and supporting your T&M needs over a wide range of industries and applications. This is what you can count on with every Fluke and Philips product you purchase.

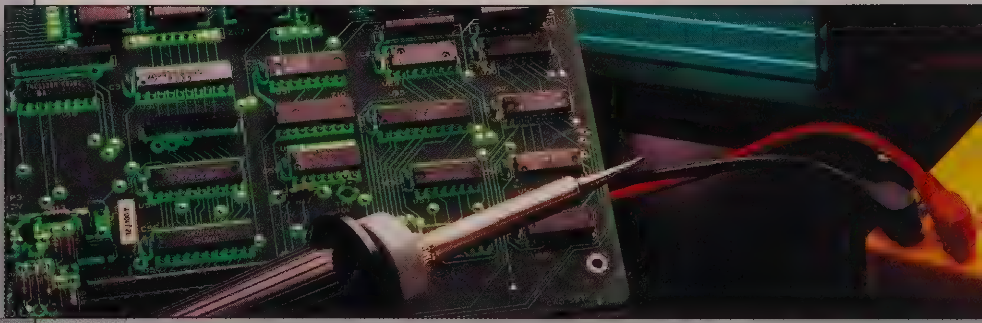
We invite you to examine our products closely, and compare them to any you are currently using or considering. We are confident that Fluke and Philips products can meet or exceed your performance requirements, while keeping your cost of ownership low.

We hope you enjoy our 1989 catalog.

Research & Development



Manufacturing



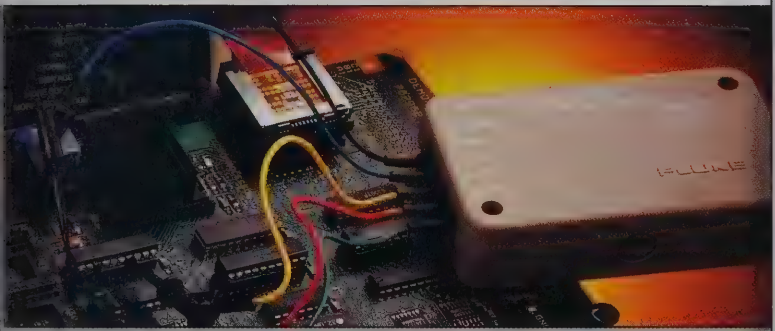
Service

Report of Calibration
John Fluke Mfg. Co., Inc.
5440B DIRECT VOLTAGE CALIBRATOR
Example of Cal Results→PC Output

Calibration

A few highlights of this year's new products

As circuitry becomes faster, so must T&M instruments - and the new PM 3340 digitizing oscilloscope uses a sequential sampling system that combines a wide 2 GHz bandwidth with unmatched 1mV sensitivity and full 2 GHz triggering. The new PM 3655 is a low-cost logic analyzer that delivers exactly what it promises. Unlike many similar instruments, its 96 channels, 100 MHz bandwidth, 2k memory/channel and 5ns glitch capture are always available in any configuration.



Two new software packages for the PC (Screen Builder and Icon Builder) provide a simple, standard method to ease generation of custom screens and diagrams for the 1030 and 1050 Series Touch Control Screens. And there are several new software packages for GPIB/IEEE systems as well.
The TestTeam Software greatly speeds test program generation for PC-based IEEE instrumentation systems. Also, a new interface card allows the IBM PS/2 to control automatic test sequences.
And a range of dedicated instrument drivers for many Fluke and Philips instruments greatly reduces your systems programming efforts.

The new 80 Series is one of the most notable multimeter introductions of the decade, offering more measurement functions and special features than ever before in a splash-proof and dust-proof handheld package. Also ideal for many service applications is the new PM 3308 scope.
It is a 100 MHz portable scope with innovations such as a flat, flicker-free electroluminescent screen and a 180 kByte RAM disk - in a lightweight, rugged portable package.

The 5700A Multifunction Calibrator handles the broadest workload of any calibrator and offers excellent DC and AC accuracy. Only three Artifact standards and about one hour are enough to set it up to maintain its accuracy and traceability to legal standards. We further extend the comprehensive range of calibration offerings with the 7411 PC software, which allows a PC to control an automated calibration system - even keeping calibration records for you.

Complete new products preview on following pages

New Products

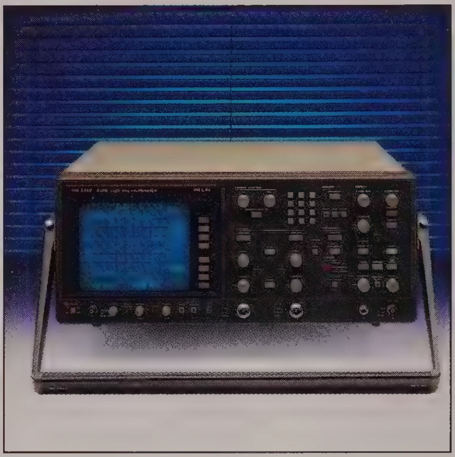
PM 3365 100 MHz, 100 MS/s Digital Storage Oscilloscope

- High performance analog and digital scope
- High 100 MS/s sampling rate on each channel simultaneously
- Full 100 MHz bandwidth
- 2 mV sensitivity
- Triggering to 150 MHz
- Multifunction AUTOSET gives instant display of signals
- Advanced automatic measurements
- Delayed Time Referencing
- Reference memories
- RS 232 and IEEE-488 interface options

The PM 3365 is the best in 100 MHz analog *and* digital performance. Full 100 MHz analog performance includes Autoset for instant display of a waveform in just 2 seconds. For single shots, the 100 Ms/s 8-bit converters on each channel reveal the smallest and fastest transient and also digitize repetitive signals extremely quickly over the full 100 MHz bandwidth in the equivalent time DSO mode. To zoom in on details, the Delayed Time Referencing mode offers the digital equivalent of delayed time base mode in an analog scope. Extensive cursor facilities and math functions allow direct measurements, and reference memories are available for signal comparisons. IEEE-488 and RS 232 interfaces are available for hard copy devices such as printers and plotters, and for full remote control.

See page 43 for full description

PM 3340 2 GHz Digitizing Oscilloscope



- DC to 2 GHz bandwidth
- 175 ps risetime
- Trigger response up to 2 GHz
- Four 4 kbyte × 10-bit memories
- 1 mV/div vertical sensitivity
- Powerful automatic measurements and signal processing functions
- Eye pattern and constellation diagrams for PCM inspection
- Autoset selects settings for instant on-screen display
- Probes operating over full bandwidth
- IEEE-488 and RS 232 interfaces

The PM 3340 sets new standards in acquisition, display and analysis of ultra high frequency signals. A full 2 GHz bandwidth and 175 ps risetime ensures accurate reproduction of the fastest edges. Triggering over the full bandwidth is standard and the many trigger modes cover most applications. 10-bit vertical resolution ensures every signal detail is visible. Extensive cursor measurement capabilities and math functions give accurate processed results "on-line". Up to 12 k sample points can be displayed on screen which, combined with the measurement functions, makes the PM 3340 ideal for PCM eye pattern or constellation measurement. It is as easy to use as standard analog instruments and, for systems use, has RS 232 and IEEE-488 interfaces included as standard.

See page 26 for full description

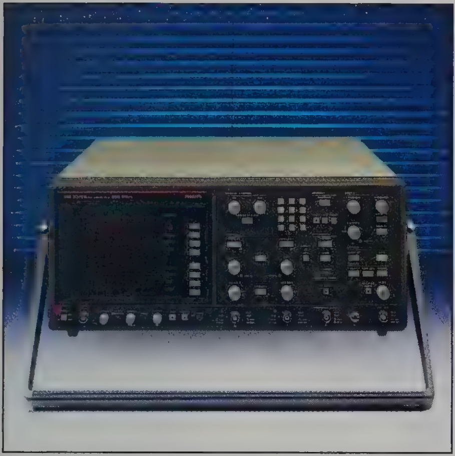
PM 3335 20 Ms/s, 50 MHz Advanced Digital Storage Oscilloscope

- Dual Analog and Digital Storage
- 50 MHz real time analog bandwidth
- Deep 8 KBytes × 8-bit waveform acquisition memory
- Second reference memory for comparison of waveforms
- AUTOSET for instant on-screen trace display
- Standard cursors for on-screen measurement functions

All the power and facilities of analog and digital scopes are combined in this economical scope. Repetitive signals up to 50 MHz can be analyzed in analog mode and for single shot work, both channels have a fast 20 Ms/s 8-bit convertor. Autoset automatically gives optimal display of the input signal. With 8 kbytes memory depth per channel, extensive pretrigger information is available. Screen cursors enable time and amplitude measurements and reference memories are available for signal comparison. Printers and plotters can be connected via the combined RS 232/IEEE-488 interface, which can also be used for remote control of the instrument and measurement transfer in small systems applications.

See page 47 for full description

NEW PM 3320A 200 MHz, 250 Ms/s Advanced Digital Storage Oscilloscope



- Maximum bandwidth of 200 MHz
- 250 Msamples/s per channel
- 4 ns realtime resolution per channel, single shots
- 10 bit vertical resolution
- Horizontal expansion up to 128 times
- Extensive cursor and math facilities
- IEEE-488 and RS 232 Interface

The Philips PM 3320A is a digital storage oscilloscope which offers a combination of high resolution signal digitizing and analysis and an easy to use front panel with softkey operation. The softkeys allow direct access to the most frequently used controls which, together with the clear panel and screen layout, make the instrument easy to use and encourages the user to make full use of its functions. The PM 3320A's features include a very fast sampling speed of 250 Msamples/s per channel; storage of traces and set-up parameters; and pre- and post-triggering allowing long time interval waveforms to be captured and analyzed in detail. Cursor measurement facilities and math functions enable extensive post processing of captured data, including even optional FFT analysis of measured signals. The PM 3320A is fully IEEE-488 and RS 232 Compatible.

See page 31 for full description

NEW PM 3308 40 MS/s Compact Digital Storage Oscilloscope

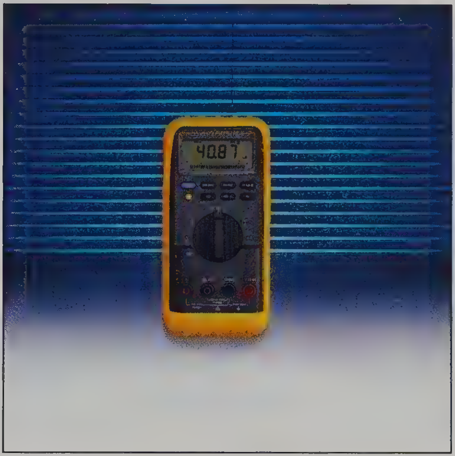
- 100 MHz bandwidth
- 40 Ms/s maximum sample rate
- Autoset for instant on-screen trace display
- Deep 8 kBytes acquisition memory
- 180 kBytes non-volatile RAM disk
- 22 cursor measurement functions
- Powerful math processing
- Large flat electroluminescent display

The Philips PM 3308 digital storage oscilloscope offers a combination of high performance and features in a small package. A flat electroluminescent display gives very sharp, clear waveform display over a wide 140° viewing angle and it can be folded flat to give a very compact, portable package. It includes a 180 kBytes non-volatile RAM disk for storage of up to 100 traces, set-ups, or a combination of both. Powerful signal processing facilities include addition, subtraction, integration and differentiation, and extensive cursor measurement capability is also provided. The PM 3308 is completely programmable within a system environment through its IEEE-488 and RS 232 interfaces, included as standard.

Available Mid 1989

See page 37 for full description

NEW 80 Series Analog/ Digital Multimeters



- Min Max Average recording mode with MIN Max Alert™
- Frequency, duty cycle and capacitance measurements
- 1000V input protection; Input Alert™ detects wrong input jack connections
- 3¾ digit, 4000 count display updates 4 times per second; analog display updates 40 times per second
- 4½ digit mode, 1 ms peak hold, back lit display and true RMS measurements (87 only)
- Touch Hold® and Relative modes
- Splash proof and dust proof case; EMI shielded
- Protective holster with Flex-Stand™
- Safety-designed test lead set

The new Fluke 80 Series (83, 85 and 87) are high performance meters with 11 functions and 40 ranges for a wide variety of electronic and industrial applications. They offer an impressive range of capabilities, including frequency, duty cycle and capacitance measurement, and feature durable construction and several unique safety features. For changing or unstable signals, the 87 features a high-resolution analog pointer, the 83 and 85 use an analog bargraph. The 83 and 85 also feature a Zoom Mode for higher resolution analog readings. Basic dc accuracy on the 83 is 0.3% of reading, the 85 and 87 feature 0.1% basic dc accuracy.

See page 110 for full description

New Products

NEW

PM 3655 Low-Cost 100 MHz 96 Channel Logic Anlayzer

- Full 100 MHz sampling speed on up to 96 channels for timing and state analysis
- 2 kbytes memory always available on all 96 channels
- 5 ns glitch capture on all channels, at full 100 MHz and with full 2 kbytes memory
- Sophisticated multi-level triggering and 4 clock qualifiers
- High quality, low impedance probes
- Simple, familiar operation
- Plus full MS-DOS-based PC

PM 3655 offers no-compromise performance at low cost. Unlike some other instruments in its class, all functions can be used at full rated spec at all times, regardless of which combination of features are in use. Sampling speed is 100 MHz on all of its maximum 96 channels. Each channel always has 2 kbytes memory available and glitch capture can capture transients down to 5 ns, still at full speed and with all the memory. State and time analyses, or combinations, are possible through the many powerful triggering functions. This performance is available in configurable modules of 24-channels each, so you can have the power matched to your needs and budget. Plus, the logic analyzer has the familiar functionality of a PC, (with menu operation, for example), for superior ease-of-use, and it operates separately as a PC, running common software packages. RS 232, Centronics and IEEE-488 interfaces are standard.

See page 153 for full description

NEW

9132A Memory Interface Pod

- Support for 32-bit designs
- Fluke's new HyperTEST™ RAM test algorithm
- Advanced diagnostic capability for isolating bus faults
- Quick memory test

The 9100A Digital Test System from Fluke now supports advanced 32-bit designs (like the 80386 and 68020) with the new 9132A Memory Interface Pod. The pod can be adapted quickly and inexpensively to accommodate future microprocessor support needs with only a microprocessor-specific personality module and software disk.

The 9132A connects to the 9100A mainframe in the same way as other Fluke pods to stimulate and test UUT circuitry, but uses a new pod technology. Connection is made through a sync module and by replacing the UUT boot ROMs with ROM modules. The 9132A accesses and controls the UUT's microprocessor through the boot ROM sockets. Instructions are passed through the ROM modules stepping the UUT microprocessor through various built-in and user-written tests. Similar to the user interface for other Fluke pods, the 9132A can be controlled through commands written in high-level language, rather than requiring the user to generate microprocessor-specific assembly code.

See page 172 for full description

NEW

5700A Calibrator

- Covers the complete DMM calibrator workload
- Precision performance that is easy to use
- Simplified support with Artifact Calibration
- Compatible to protect your investment

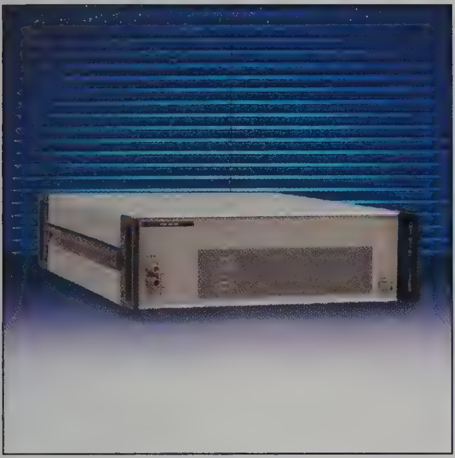
The new 5700A Calibrator is designed to deliver outstanding performance while minimizing the costs associated with supporting and using a high-accuracy instrument.

Only three Artifact Standards are required to perform periodic calibration of all 5700A ranges and functions. And internal references and the unique Cal Check feature make it convenient to verify performance between calibrations. Full, independent verification of the 5700A is extended to two years.

The 5700A is designed to calibrate the broadest cross section of your meter workload. It delivers direct voltage to 1100V and alternating voltage from 200 μV to 1100V at frequencies from 10 Hz to 1.2 MHz. Cardinal point resistances range from 1 Ω to 100MΩ in x1 and x1.9 decades, including a short. Alternating and direct current are provided to 2.2A, and frequencies for alternating current range from 10 Hz to 10 kHz. The wideband voltage option extends alternating voltage frequences from 10 Hz to 30 MHz.

See page 187 for full description

5725A Amplifier

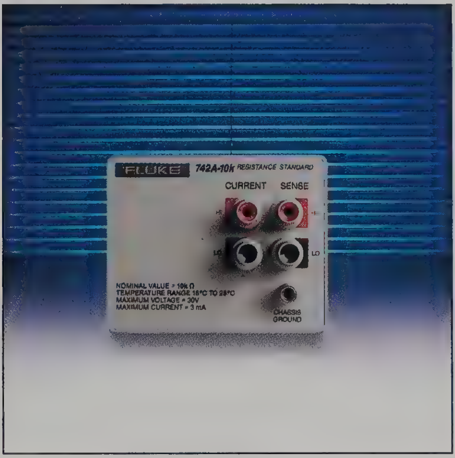


- Companion to the 5700A calibrator
- Extends current and Volt-Hertz capability.

The 5725A is a companion instrument to the 5700A. It increases the maximum current output of the calibrator to 11 A for calibrating the high current ranges of popular handheld DMMs. It also extends the 5700A's alternating Volt-Hertz product to 100V at 30 kHz and 750V at 100 kHz to cover the calibration requirements of high-accuracy bench and system meters.

See page 187 for full description

742A Resistance Standards



- Small and rugged
- No oil or air baths required
- 18°C to 28°C operating range
- Six month stability to 2.5 ppm

Fluke 742A Standard Resistors are high accuracy working standards for precision, on-site resistance calibration.
They are small, rugged and easy to transport. No cumbersome oil or air baths are required. The 742As are ideal for supporting the Artifact Calibration of the 5700A Calibrator.

See page 228 for full description

7400 Series Automated Calibrated Systems

- Choice of PC-compatible or Fluke 1722A instrument controller
- A wide selection of calibrators, packaging, auxiliary instruments and support are available.
- Easy to learn and to use

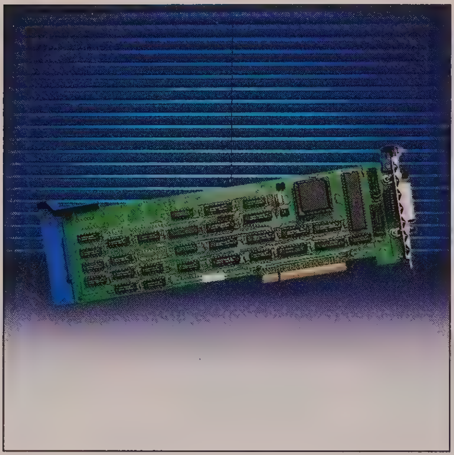
Fluke 7400 Series Automated Calibration Systems are designed to offer you a complete solution to the complex task of matching the calibrator, host computer and software, packaging and other accessories with your workload requirements and your budget.

See page 220 for full description

New Products

NEW

PM 2202 MC-GPIB Interface Board for IBM PS/2



- Turns an IBM PS/2 into a versatile GPIB/IEEE-488 controller
- Hardware configuration completely software programmable
- Easy to use GPIB/IEEE-488 drivers for BASIC, C and Pascal
- Programming of GPIB/IEEE-488 instruments easy with PM 2230 Series, PM 2240 and PM 2260 GPIB software packages

The PM 2202 is an extremely advanced GPIB/IEEE-488 interface for the IBM Personal System/2 (equipped with Micro Channel plug-in-slots). The PM 2202 consists of an interface card plus driver software, and turns the PS/2 into a flexible instrument controller for systems with up to 14 instruments. The interface board allows a maximum transfer rate of 1 MByte/sec, fast enough for the most demanding applications. All board settings are fully programmable and installation is quick and simple. The PM 2202 supports all commonly used GPIB/IEEE-488 functions, with routines that can be included in application programs written in GWBASIC, BASICA Microsoft™ Pascal and Microsoft C. Besides standard GPIB drivers, the PM 2202 is supported by software packages specifically designed to ease programming, debugging and waveform processing. It is software compatible with the PM 2201 GPIB interface for the IBM PC, so application software written for the PC or PS/2 can be exchanged without modification.

See page 379 for full description

NEW

PM 2230 Series of GPIB Instrument Drivers

- Automatic configuration utility for fast system configuration
- High level instrument commands ease programming
- Extensive built-in error checking and reporting
- Includes easy to use GPIB/IEEE-488 drivers
- Support for BASICA, Pascal, C & QuickBASIC
- Available for IBM PC's and PS/2's

PM 2230 Series of instrument drivers simplifies programming GPIB/IEEE-488 instrumentation systems and results in self-documenting, error-free application programs. The automatic configuration utility determines the GPIB system configuration, including instrument addresses and type, and assigns a user-defined name to each instrument. Application programming can thus start immediately after running this utility. High level instrument drivers have commands as simple to understand as the instrument front panel, reducing programming time and resulting in easy-to-read application programs. The instrument drivers automatically check program validity; for example, programming an instrument out of range, or programming an incorrect combination of settings, results in clear, readable, error messages. In addition to supporting a large range of Fluke & Philips instruments, the instrument drivers contain a complete set of GPIB procedures for controlling any GPIB instrument, and support BASICA/GWBASIC, QuickBASIC, Microsoft C & Pascal.

See page 376 for full description

NEW

PM 2240 TestTeam Software

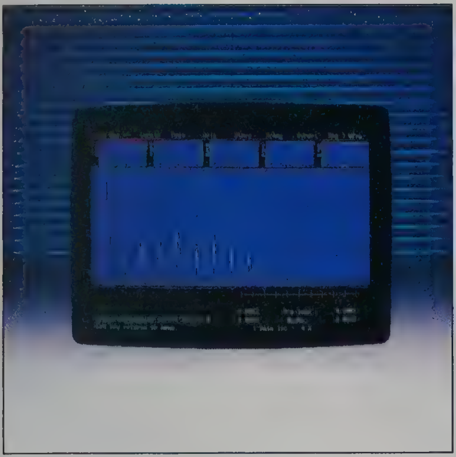
- Fast, easy program generation for GPIB/IEEE-488 instrumentation set-ups
- Easy to use, menu-oriented operation with pull-down menus and pop-up windows
- Extensive instrument library
- Parameters programmed by on-screen instrument panels
- Built-in graphics and analysis functions for simple on-screen data presentation
- Powerful debugging & error handling tools for error-free programs
- Available for IBM PC's or PS/2's

The PM 2240 TestTeam provides a complete, easy-to-use programming environment for GPIB/IEEE-488 application programs in Microsoft™ QuickBasic or C. Application programs are written using a user-friendly, visual editor and functions are selected via pulldown menus or pop-up windows. A built-in instrument library supports an extensive number of instruments and programming a GPIB instrument is accomplished by simply selecting from an on-screen instrument panel. Standard graphics and analysis libraries greatly simplify presentation of measurement data on screen or in printed form. Extensive debugging and error handling facilities are included.

See page 374 for full description

NEW

PM 2260 Oscilloscope Signal Processing Software



- Extensive waveform analysis and display functions all accessible via menus and function keys
- Menu driven data transfer from Philips Digital Storage Oscilloscopes to PC
- Fast data transfer via GPIB/IEEE-488
- On-line help facility

The PM 2260 Oscilloscope Signal Processing (OSP) software combines the extensive range of waveform analysis functions of the ASYSTANT™-GPIB software package, with the very advanced data acquisition capabilities of Philips Digital Storage Oscilloscopes (DSO). Data captured with a Philips DSO can be easily transferred to the PC via the GPIB/IEEE-488 interface, under control of a menu-oriented driver, with no programming skill or effort required. On the PC, data can then be quickly analyzed, processed and displayed. Processing functions include FFT, power spectrum, inverse FFT, differentiation, integration, Blackman window, curve fitting, cross-correlation and many more. Additional mathematical functions include extensive array operations, statistics and multi-window graphics facilities. Hard copy output to printers and plotters is also supported.

See page 377 for full description

NEW

Touch control screen software development tools

- ScreenBuilder™ for stored screen development
- IconBuilder™ for custom character font development
- TCS Toolbox™ for simplified application program development

ScreenBuilder is a development tool that allows the user to completely develop stored screens for the 1030 or 1050 Series TCS. The user simply "fills in the blanks" on this interactive program that runs on the IBM PC or equivalent.

IconBuilder allows the user to create character fonts and icons for custom displays on the 1030 and 1050. As with ScreenBuilder, IconBuilder is an interactive, "fill in the blanks" program that runs on the PC.

The TCS Toolbox provides a programmer with QuickBASIC functions that greatly simplify the development of a run-time application program. While the TCS Toolbox can be used with any 10XX TCS product, it is best suited for the 1020 Series.

See page 434 for full description

NEW

PM 8238 Multipoint data recorder

- Long term reliability for chart recording
- Maximum 30 input channels, scanned at 10/s
- Graphic or numeric data presentation
- Optional alarm output plug-in cards
- Interpolation between measuring points for continuous line-plots
- Memory modules for user-program storage
- AX + B scaled measurements

The PM 8238 30-channel data recorder is ideal for applications requiring long term stability and reliability, such as extended unattended recording. Chart output is in numeric format (for clear presentation of values), graphic (for spotting trends), or both in combination. Accurate measurement of temperature and voltage covers a span of 1 mV to 30 V and the thermal printing system ensures long term, high quality printing even in dusty environments. All functions or parameters entered for a channel can be quickly selected and verified on the LED display; and a scaling function allows outputs to be displayed in any required units. An internal clock allows time/date labelling. User set-ups and programs can be stored in memory modules, and a choice of IEEE-488 or RS 232C interface options also allows remote control of all data recording activities.

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Alphabetical

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† RS-232-C

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If you'd like more information on new product and service solutions to your test and measurement problems, here are two easy ways to get help. One is to add (or update) your name and product interest information to our mail list. You'll be interested to know that besides the many new products featured in this catalog, several major new offerings are planned for this year. By filling out the postage-paid reply card below and mailing it to us, you can be among the first to receive new product information and technical updates.

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- ☐ C0 **General Purpose Test Equipment** (Digital/Analog Scopes, Power Supplies, Counters, Pulse/Function Generators, Benchtop/System DMMs)
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- ☐ F0 **Testing of Digital Equipment** (Logic Analyzers, Digital Service Instruments, Board Testers)
- ☐ G0 **Bus/Interface Instruments** (System Switches, Controllers, GPIB Interface Cards)
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Oscilloscopes

The range of oscilloscopes detailed in this section covers R&D, production, and service applications.

It includes a complete range of 60, 100, 200 and 400 MHz analog oscilloscopes, most featuring Philips' innovative AUTOSET capabilities. This sets channel amplitude timebase and triggering to give fast, single button measurements of unknown signals. This range also offers GPIB/IEEE-488 interface capabilities.

Analog storage models offering storage writing speeds up to 1 div/ns are also included.

In addition, digital storage oscilloscopes range up to 2 Ghz response, and feature the fast 250 MS/s, 200MHz PM 3320A, and the new PM 3365. This 100 MS/s, 100 MHz oscilloscope offers a cost effective solution to a great number of applications formerly covered by analog storage techniques, yet with an ease of use comparable to an analog scope.

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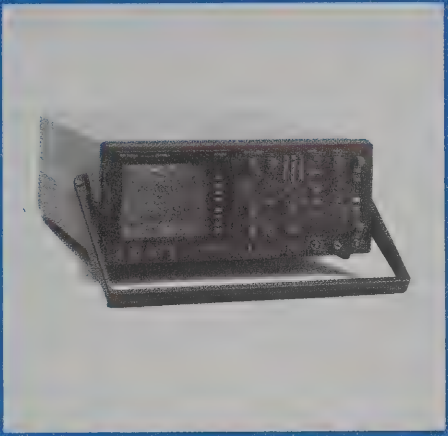

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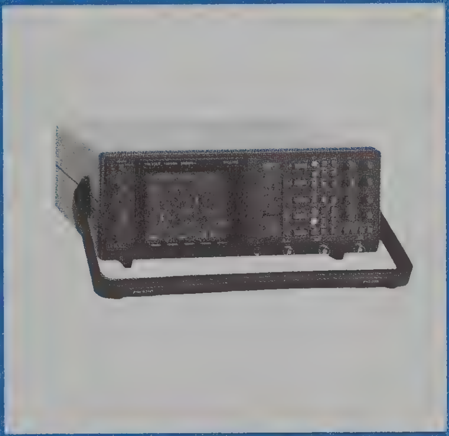

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Selection Guide

Model	Bandwidth (Risetime)	Timebase	Trigger Bandwidth	Acceleration Voltage	Channels	Dual Timebase	Cursors	GPIB	Autoset	Page
Analog Oscilloscopes										
PM 3295A/96A	400 MHz (0.875 ns)	1 ns/div.	400 MHz	24 kV	2 + 1	YES	YES	YES (95A OPT.)	YES	7
PM 3285A/86A	200 MHz (1.75 ns)	2 ns/div.	250 MHz	16 kV	2 + 1	YES	YES	YES (85A OPT.)	YES	7
PM 3070	100 MHz (3.5 ns)	5 ns/div.	150 MHz	16 kV	2 + 1	YES	YES	YES (OPT.)	YES	11
PM 3065	100 MHz (3.5 ns)	5 ns/div.	150 MHz	16 kV	2 + 1	YES	NO	YES (OPT.)	YES	11
PM 3264	100 MHz (3.5 ns)	5 ns/div.	100 MHz	17 kV	4 + 1	YES	NO	NO	NO	16
PM 3055	50 MHz (7 ns)	5 ns/div.	100 MHz	16 kV	2 + 1	YES	NO	YES (OPT.)	YES	11
PM 3050	50 MHz (7 ns)	5 ns/div.	100 MHz	16 kV	2	NO	NO	YES (OPT.)	YES	11
Analog Storage Oscilloscopes										
PM 3266	100 MHz (3.5 ns)	5 ns/div.	100 MHz	10 kV	2 + 1	YES	NO	NO	NO	19
PM 3219	50 MHz (7 ns)	10 ns/div.	50 MHz	8.5 kV	2	YES	NO	NO	NO	21

Digital Storage Oscilloscopes

Models	Bandwidth (Risetime)	Sample Rate	Max. Stored Frequency	Acquisition Memory	Ref. Memory (Waveforms)	Vertical Resolution	Channels	Waveforms On Screen	Cursors	GPIB	RS-232	Page
PM 3340	2 GHz (175 ps)	—	2 GHz	0.5k	1.5 k (6)	10-bit	2	8	YES	STD	STD	26
PM 3320A	200 MHz (1.75 ns)	250 Ms/s	200 MHz	4k	12k (6)	10-bit	2	8	YES	OPT	OPT	31
PM 3308	100 MHz (3.5 ns)	40 Ms/s	100 MHz	8k	180k (99)	8-bit	2	4	YES	STD	STD	37
PM 3365	100 MHz (3.5 ns)	100 Ms/s	100 MHz	4k	4k (2)	8-bit	2	4	YES	OPT	OPT	43
PM 3350	50 MHz (7 ns)	100 Ms/s	10 MHz	4k	4k (2)	8-bit	2	4	YES	OPT	OPT	41
PM 3335	50 MHz (7 ns)	20 Ms/s	2 MHz	8k	8k (2)	8-bit	2	4	YES	OPT	OPT	47
PM 3305	35 MHz (10 ns)	2 Ms/s	35 MHz	2k	2k (2)	8-bit	4	8	NO	OPT	NO	50

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Oscilloscopes Introduction

Oscilloscopes are available from a wide variety of sources and manufacturers. The number of sources available however, becomes limited, when such elements as design innovation, excellence of engineering and worldwide service and parts support are evaluated. Philips oscilloscopes are the products of one of the worlds largest electronics' companies, with annual sales in excess of $ 29 Billion, and yearly budgets of over $ 1 Billion spent on basic research. These total capabilities in analog and digital electronics, manufacturing and fabrication techniques, in addition to worldwide service and support, make the choice of a Philips oscilloscope in many applications a prudent decision.

Selection Criteria

In the following paragraphs, a number of functions for analog oscilloscopes are discussed, along with the selection criteria for each. (For more information on Digital Storage Oscilloscopes, see page 23).

What Are the Functional Blocks of an Oscilloscope?

CRTs

One of the last surviving species of the vacuum tube family, Cathode Ray Tubes (CRTs) are the prominent display devices used in Radar, Computers, Medical equipment and Oscilloscopes. Except for oscilloscopes, most of the CRTs for these applications use some form of electromagnetic deflection.

In an oscilloscope CRT, deflection is electrostatic, allowing a wide range of voltages and frequencies to be displayed with a minimum of distortion.

What CRT criteria are most important to the user?

- Accelerating potential, determining light output and writing rate, important when viewing low repetition rate signals at high sweep speeds. Philips oscilloscopes offer the highest acceleration potentials in each bandwidth/price class, ensuring maximum visibility of the signals under the most demanding measurement circumstances.
- Screen size, usually measured in centimeters.
- Graticule, external or (mostly) internal, to avoid parallax.
- Graticule illumination for photographic recording.

Multiple Channels

Many oscilloscope applications require the ability to compare two or more waveforms to show amplitude differences, distortion, or time differences.

Dual Beam oscilloscopes allow the comparison of waveforms by using a CRT with two electron guns and two deflection systems, to display two completely independent oscillograms on the same screen.

In such an arrangement, two completely independent amplifier systems are required and they must be matched properly so as to not introduce distortion or time differences of their own. At higher frequencies this becomes a more difficult requirement to meet, and prohibitively expensive for most applications. Most analog oscilloscopes therefore operate on the Dual Trace principle described below.

Digital storage oscilloscopes with synchronous Analog to Digital conversion on each channel prove to be excellent replacements for the Dual Beam oscilloscope.

Dual Trace

The most common way to display two (or more) signals on the screen of an analog oscilloscope uses the dual trace principle.

Input signals are connected to the output amplifier and CRT deflection system in turn, in a time-shared manner, using an electronic switching arrangement between channels which is either free-running at a high frequency (CHOP) or changes channels at the end of every sweep (ALTERNATE). Philips oscilloscopes feature the highest CHOP frequencies in their respective bandwidth class, so as to ensure proper displays at the highest possible sweep rates, without visible interference of channel switching.

Some oscilloscopes are designed to display more than two channels in this fashion, either by having more than two full vertical input channels, or by allowing a trigger signal to be displayed. The Philips PM 3264 l00 MHz four channel oscilloscope offers the convenience of four complete vertical channels, each with its own full-range sensitivity setting, plus a fifth channel trigger view.

Vertical Channels

A vertical channel is comprised of: An input connector, Coupling selector for AC or DC coupling, Selection of input impedance (only in VHF scopes), Attenuator or sensitivity adjustment, Position control, (Display invert switch), (DC-offset).

What Amplifier criteria are most important to the user?

- Bandwidth, specified as the frequency range between DC and the point where the frequency characteristic has fallen to its -3 dB point. Philips analog oscilloscopes are available with bandwidths beginning at 15* MHz, up to 400 MHz.
- Risetime. The risetime and bandwidth of an oscilloscope have a known relationship to each other: Risetime (in ns) x Bandwidth (in MHz) = 350.
- The risetime of an oscilloscope determines the ability of the instrument to deal with short events, such as rise times of components used, glitches etc.

*20 MHz in U.S.

- To determine the required risetime (or Bandwidth) of an oscilloscope to perform a particular measuring task, the following may be helpful:
  $T(\text{observed}) = \sqrt{T(\text{signal})^2 + T(\text{oscilloscope})^2}$
  Philips oscilloscope rise times are always specified at the tip of the probe delivered with the instrument.
- Maximum sensitivity, expressed in mV/div to be able to cope with spurious signals: crosstalk, power supply ripples, faulty components.
- Minimum sensitivity, expressed in V/div, to include direct measurements of high amplitudes, such as line, HV power, etc.
- Accuracy, in %.
- Maximum input (overload) voltage permissible at the input without causing damage, to reduce cost of ownership.
- Choice of input impedance. Most oscilloscopes are equipped with inputs of 1 Mohm, in parallel with their input capacitance. Philips oscilloscopes have unusually low input capacitances (only 9 pF in the 200 MHz and 400 MHz models).
  All Philips oscilloscopes with bandwidths of 200 MHz and higher offer a choice of 50 ohm inputs. This serves two purposes :
  1. To provide a convenient and proper termination to coaxial cables when working in a 50 ohm environment.
  2. To allow the use of low impedance passive 10x and 100x probes with extremely low input capacitances of 1 pF.
     (See PM 8911/09 and PM 8912/09).

Timebases

Sweep generators generate a voltage, the value of which increases linearly with time. This linear ramp voltage is fed into the horizontal amplifier of the instrument and calibrated in time. The timebase generator does not start its sweep until triggered by a trigger signal.

When each successive sweep is triggered at the same level and slope of an incoming repetitive signal, sweeps will always start at the same point of the signal, and a stable, jitter-free display is obtained.

What Timebase criteria are most important to the user?:

- Minimum sweep speed, expressed in sec/div.
- Maximum sweep speed, expressed in microsec/div or nanosec/div
- Accuracy
- Linearity

Triggering

Triggering is the mechanism which defines the starting point of every successive sweep. It defines the stability of the display and is usually the most prominent characteristic of the user-friendliness of the entire instrument. Trigger signals are obtained from either a vertical channel (Internal triggering), or an external source.

Introduction

What Triggering characteristics are most important to users?

- Choice of trigger sources, to help find and set up the most stable trigger and display condition for each application. Philips oscilloscopes invariably offer a full complement of trigger source selection to tackle the most demanding and complex waveforms.
- Maximum triggerable frequencies, also defining the ability to trigger on small signal details and glitches. Philips oscilloscopes trigger well beyond their rated bandwidth.
- Trigger jitter, or rather the lack thereof, to assure stability of display.
- Automatic trigger level adjustment or manual adjustment between automatically detected signal limits. This translates to ease of operation. Thanks to AUTOSET on Philips oscilloscopes, trigger source, trigger level, timebase speed and vertical sensitivity are all automatically set for instant signal viewing.
- Features such as High or Low pass filters, Trigger view.
- TV triggering capabilities to deal with Video signals as are found in TV sets, cameras, VCR's, but also Radar, Medical and Computing equipment. In such applications, Philips video triggering capabilities are exceptional.
- In order to permit viewing the triggering edge of a waveform, all Philips oscilloscopes are equipped with a delay line in the vertical amplifier chain.

Dual Timebase/Delayed Sweep

To resolve signal details in time and to allow for more accurate timing measurements, many oscilloscopes with bandwidths of 50 MHz or more are available with two timebases, so that one serves as a delay generator for the other.

Signal details are identified with an intensified portion of the display of the main timebase (MTB), which can then be selected to be displayed across the entire screen width, using the delayed timebase (DTB).

Delay is calibrated in divisions, which can be calculated into time, taking the timebase speed of the main timebase (MTB) into account. Modern Philips microprocessor-operated scopes perform this calculation automatically and present calibrated delay values in time.

What Delayed Sweep criteria are most important to the user?:

- Choice of models with, or without delayed sweep. Sometimes, single timebase models are preferred to save (some) money in the purchase price, but especially in training requirements of personnel.
- User friendliness. Philips delayed sweep oscilloscopes are always easy to use with their clear, and uncluttered layout and separate control areas for main and delayed timebases.
- Direct readability of delay in time. All Philips microprocessor operated oscilloscopes offer this convenience.
- Triggering capabilities of the delayed timebase. All Philips delayed sweep oscilloscopes offer a full, and independent choice of trigger settings for their main- and delayed timebases: A MUST for every type of measurement in the digital field.

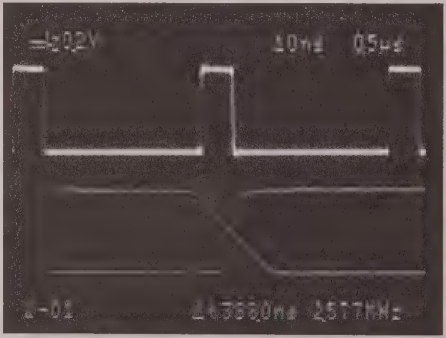
Dual Delayed Sweep

By alternating delay times between successive sweeps of the main timebase generator, TWO signal details can be identified along the sweep of the main timebase, and the difference in time is measured.

This capability is referred to as dual delayed sweep or delta-time capability. Some Philips oscilloscopes permit the measurement of time delays between one detail in one channel, and another detail in another channel.

What Dual Delayed Sweep criteria are most important to the user?:

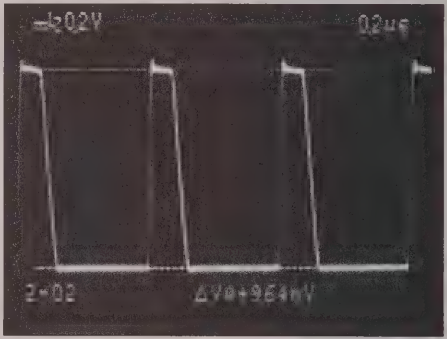
- User friendliness
- Readability of delta time
- Capability to read the inverse of time, expressed as frequency.
- Ability to measure between channels.



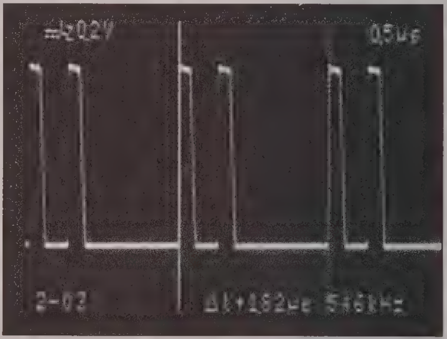
Accurate time readouts are easily obtained with the PM 3296A's delta time dual delayed sweep arrangement.

Cursors Measurements on Analog Scopes

Cursors on analog scopes are movable lines, replacing the role of the graticule lines. Adjustments are always made by the operator. Distances between the cursors are displayed alphanumerically and represent amplitude or time. Cursors add convenience to oscilloscope measurements. Voltage accuracy is determined by the accuracy of the overall attenuator and amplifier chain. Timing accuracy is determined by the accuracy of the Main timebase. When small timing increments are to be measured, measurements using delta-time facilities as described above offer better accuracy.



The PM 3296A's cursors allow easy readouts of absolute and relative amplitudes.

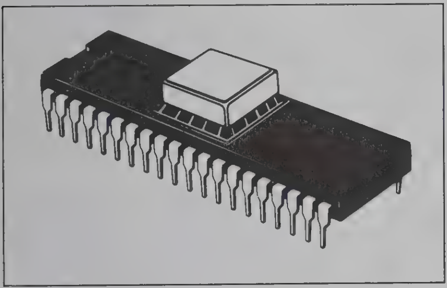


Cursors can be used for time readouts as well. Time intervals are presented in (fractions of) seconds. 1/T readouts are presented in Hz.

Operation

Autoset

Most Philips oscilloscopes are microprocessor operated. The intelligence of the microprocessor, along with the cold switching technology employed in many Philips instruments, combine to offer the industry's first, and most complete AUTOSET feature. AUTOSET is a one-button feature, which automatically selects the proper channel(s), selects the proper trigger source and other trigger conditions, and sets attenuator and timebase ranges. AUTOSET not only speeds up operation with known signals, it helps find unknown signals during trouble shooting, with great ease. AUTOSET is available on Philips 60, 100, 200, 400 MHz analog scopes as well as on the Digital Storage models PM 3308, PM 3320A, PM 3335, PM 3340, PM 3350 and PM 3365.



Ease of Use

The AUTOSET feature on many Philips models, as well as the clear and logical front panel layouts ensure ease of use throughout the product line. For many routine tasks in production and service, a number of Philips oscilloscopes are available with extensive menu operation, in which complete front panel setups can be stored in non-volatile memories, and recalled at random, or in sequences.

Engineering Excellence and Durability

Philips is a recognized leader in CRT technology and electron-optics. CRT's used in Philips oscilloscopes are glass-envelope, high lead content, low radiation types. Philips oscilloscopes meet or exceed even the tough West-German requirements on X-ray radiation. Excellent display sharpness and intensity are obtained by such elements as high acceleration potentials, dynamic focusing, TDR adjusted helix deflection systems and magnetic error correction.

Controls on many Philips oscilloscopes are not what they used to be:

Complex, failure prone electro-mechanical devices such as attenuator and timebase switches have been replaced by microprocessor controlled, sealed switching arrangements in reed-relays and solid state, so that switch failures and worn or dirty contacts are a thing of the past. Reliable and stable operation is assured over long lifetimes.

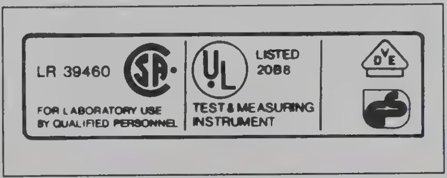
Power supplies in many Philips oscilloscopes are high-efficiency, direct-conversion types that operate over wide ranges of supply voltages and frequencies. Their high efficiency ensures cool operation of the instrument, adding to the overall reliability. Philips oscilloscopes are available for world wide use, many without the need of range-switching or fuse changes. See product descriptions for details.

Quality Assurance and Reliability

All Philips oscilloscopes meet stringent published requirements regarding environmental characteristics. Many of these requirements are referenced to MIL 28800 D. See product description for details.

Safety

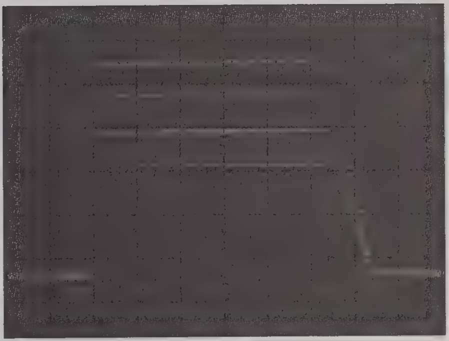
All Philips oscilloscopes meet the requirements on instrument safety per IEC 348. Most Philips oscilloscopes are UL listed (UL 1244) and CSA approved (CSA 556 B), and meet VDE D411. See product descriptions for details.


LR 39460
FOR LABORATORY USE BY QUALIFIED PERSONNEL
LISTED 2088
TEST & MEASURING INSTRUMENT

Analog Storage Oscilloscopes

(For more information on Philips Digital Storage Oscilloscopes, see page 23)

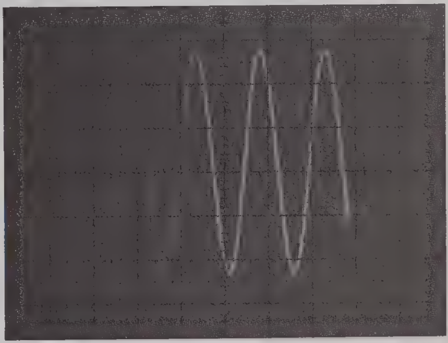
Most oscilloscopes are supplied with CRTs having a P 31 phosphor. This phosphor type has a short persistence, and is adequate for all applications in which signals have repetition rates of 40 Hz or more. Below such rates, image flicker becomes annoying and single events can not be observed or measured. For these situations, Storage Scopes offer a solution by storing signals with low frequencies down to single shots and displaying them during a longer time period.



An analog storage oscilloscope's ability to store multiple traces, as shown here taken from a PM 3219.
Example: Multiple trace images like these are used in medical electronics and industrial electronics to verify X-Ray equipment performance at various acceleration potentials.

Analog Storage oscilloscopes store images inside their CRT. To this day, these instruments are capable of storing the shortest events by offering the highest writing speeds; the ability of the instrument to capture and display fast single events at high timebase speeds. (See PM 3266)

Analog Storage scopes also offer Variable Persistence, to allow the user to observe slow trend changes in repetitive signals, or to permit low frequency signals to be displayed without flicker.



Variable persistence is a convenience feature when observing low frequency signals or signals with slow variations in amplitude or time.

Storage Scopes can not only store and display single events: they can also enhance displays of signals that may otherwise be (almost) invisible: fast glitches or short rise times that occur at low repetition rates.

What Analog Storage Scope characteristics are most important to the user?:

- Writing speed, expressed in cm/microsec, or cm/nanosec. The Philips PM 3266 offers 1 cm/ns across the entire screen area!
- Halftone storage, offering variable persistence and (often overlooked), the ability to enhance image brightness for low repetition rate signals that might be impossible to see with a non-storage scope. Both the PM 3219 and PM 3266 offer variable persistence.

Introduction

Storage Oscilloscope Selection Criteria

Listed below is a comparison between the typical characteristics of Analog, or CRT storage, and Digital Storage oscilloscopes.

	CRT Storage	**Digital Storage***
Available Models	PM 3219 PM 3266	PM 3305 PM 3308 PM 3320A PM 3335 PM 3350 PM 3365 PM 3340
Speed	Highest writing speed available : 1 div/ns (PM 3266)	Highest single event sampling speed of 250 Ms/s (PM 3320A)
Memories	One : the screen	Up to four memories built in.
Memory Size	8x10 cm	Up to 10 bits x 4k (PM 3320A, PM 3340)
Multichannel Recording	Limited by CHOP frequency	Up to 250 Ms/s for each channel (PM 3320A)
Storage Time	Limited by CRT	Unlimited with power on Memory backed up in most Philips DSO's.
"Baby Sit Mode"	Limited by CRT Max. of 24 hrs in PM 3219.	Unlimited storage time.
Outputs	The screen	1. The screen 2. Analog out for X-Y recorders 3. IEEE 488 4. RS 232
Hard Copy	Screen photos	1. Screen photos 2. X-Y recorder 3. Plotter
"Soft Copy"	None	Mass storage in instrument controller, or RAM (PM 3308)
Automation	None	1. Built-in menus (PM 3320A, PM 3340) 2. Thru IEEE 488 or RS 232
Display	1. Normal, no memory 2. Variable persistence 3. Integration of intensity for enhanced visibility 4. Stored, variable brightness	Always at a uniform brightness, regardless of signal frequency and timebase speed
Cost of Ownership	Every storage CRT is expensive and represents a major expense when damaged.	CRT can not be damaged by operator error.

**For more information on Digital Storage Oscilloscopes, see page 23.*

PM 3285A, PM 3286A, PM3295A & PM 3296A

GPIB IEEE-488

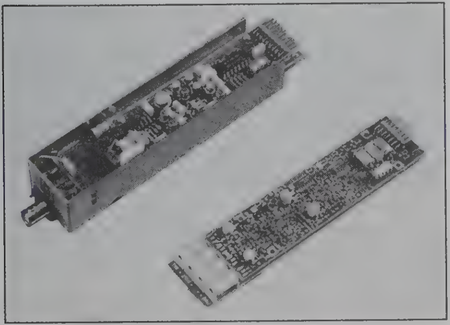
PM 3296A

PM 3285A/86A 200 MHz & PM 3295A/96A 400 MHz Oscilloscopes

Bandwidths of 400 MHz and 200 MHz
Risetimes of 0.9 ns at the probe tip (1.75 ns for PM 3285A/86A)
High visual writing speed CRT's
AUTOSET
Menu operation from 75 non-volatile memories
Cursor measurements for volt, time and frequency
Dual delayed sweep
LCD and LED status information for positive feedback

Performance

The PM 3285A/86A and PM 3295A/96A VHF oscilloscopes redefine portable, monolithic oscilloscope capabilities. With more capabilities and more straight foward operation than you will find in other portables.


The PM 3295A/96A split-band, drift corrected preamplifier, using state-of-the-art SMD technology.

Up to 400 MHz bandwidth offers portable subnanosecond performance all the way to the probe tip. Excellent for a wide array of applications including communications, avionics, radar, data processing and video processing.

CRT's with 24 kV acceleration potentials for optimum viewing. Ultra-fast writing speeds of up to 4 div/ns reveal the most elusive details and the narrowest glitches — even at high sweep speeds and low signal repetition rates. Triggering performance is in excess of 400 MHz, stable, and easy to use.

Probe factors are read out automatically. Philips probes automatically adjust the input for proper impedance setting and, where appropriate, sensitivity ranges. 50 Ohm input impedance can be selected. The 50 Ohm termination is protected by software, as well as a thermal sensor on the thin film circuit, causing the microprocessor to disconnect the 50 Ohm load, when overload conditions lead to overheating.

Autoset

Philips' AUTOSET is the first and the most comprehensive intelligent beamfinder available. It automatically selects the proper channel and trigger source for a properly triggered display, and sets amplitude and timebase speed to obtain optimum viewing of almost any input signal, even unknown, at the touch of just one button.

Built-in Programmability

For quick, correct measurements in routine tasks time after time, the PM 3286A and PM 3296A models offer programmability without a computer, by offering up to 75 front panel setups to be stored in non-volatile memory. These menus can be stored, modified and recalled at random or in sequences by using Philips IR remote control.

Cursor Measurements

On-screen cursors let you measure waveform parameters exactly as you see them, easily, with the screen providing numeric readouts of voltage, time and frequency. Absolute and relative measurements (referred to any reference as 100%) can be easily obtained.

Delayed Sweep and Delta-Time

Both timebases can be set to up to 1 ns/div, to match the risetime performance of the vertical channels (2ns/div for PM 3285A series). Delay values are visible in the screen and on the backlit LCD. The dual delayed delta time feature permits accurate differential time and frequency measurements.

Trigger Level Readout

Trigger levels can be set and adjusted using the level readout on the screen. Levels are displayed in divisions, or volts, for internal and external triggering respectively.

PM 3285A, PM 3286A, PM3295A & PM 3296A

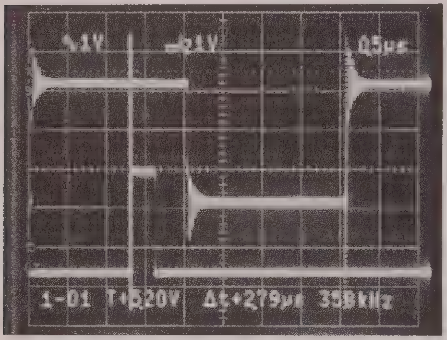
High Performance Engineering

Operation is based on microprocessor controlled cold-switching, in which all signal paths are switched in sealed environments, with no switches to wear out, or get dirty, ever. Not only does this arrangement enhance reliablity, it also permits the full implementation of before-mentioned AUTOSET, and programmability. Opto-encoders replace the front panel switches and provide control over the internal bus.

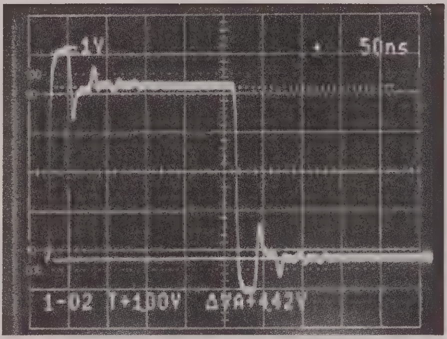
Programmability

GPIB/IEEE-488* is fully implemented in the PM 3286A and PM 3296A, at no extra charge. All front panel settings except intensity and focus are programmable. The controller can always interrogate the units' settings via the IEEE-488 bus. Programmability is further enhanced by the instrument's menu storage, allowing the scope to be controlled by simple, single commands via the bus.

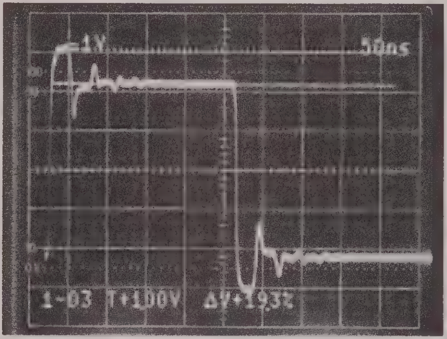
Versatility



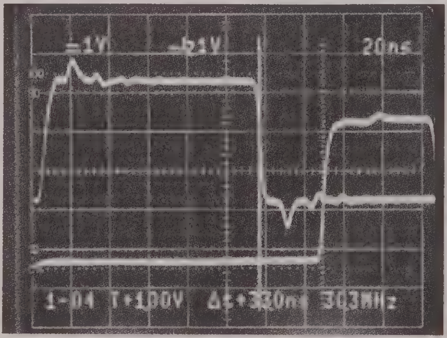
1. At the heart of these portables is Philips' proprietary 8 x 10 cm, 24 kV CRT, assuring bright, clear display of even the fastest signals. Graticule illumination is continuously variable. Intensity controls for traces and text are separate.
A complete information center, the screen exhibits input impedance, input coupling and scalefactor for each channel. Probefactors are automatically recalculated. Timebase speeds are displayed and corrected for magnifier use.
Delta time or cursor readouts appear in the lower righthand corner.
Trigger level is displayed in Volts (for Ext trigger) or Div (for Int trigger). Cursor time readouts are displayed in delta time and Hz.
Setting readouts are duplicated in LEDs and backlit LCDs on the front panel.
Input impedance is automatically set by the probe, so no mismatch can occur. Note the test sequence number in the lower left corner of this PM 3296A display.



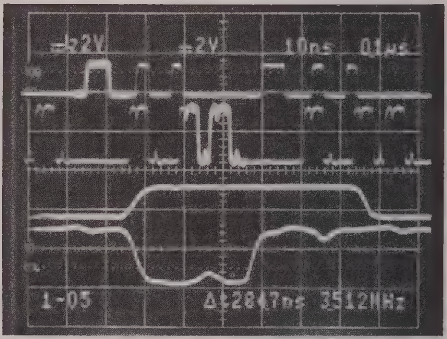
2. Channel is DC coupled at 1 V/div. Timebase is set at 50 ns/div. Cursor readout of pp amplitude is 4.42 Volts, and is referred to as 100% for the overshoot measurement in picture 3.



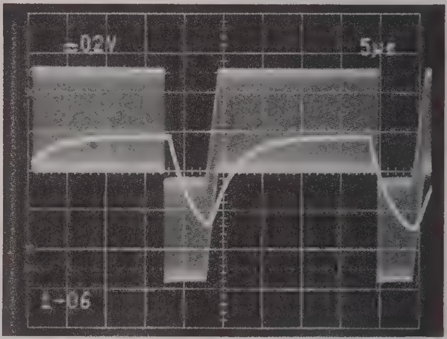
3. The PM 3296A's ability to set any amplitude as a reference lets you take quick readings of overshoot percentages — as in this picture — or measure modulation depth of an AM signal.
Note that the scope can perform relative measurements while channels remain calibrated.



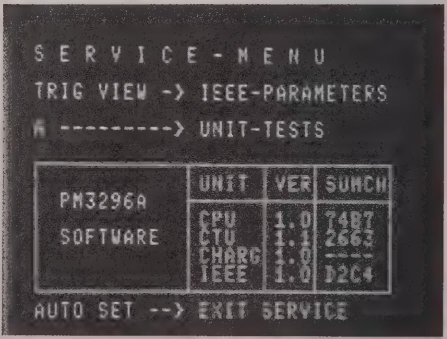
4. Cursors can be used to measure time between two events in the same signal, or between signals. Readout is in (fractions of) seconds, or in Hz.
Time measurements using cursors are simple to make and permit relative time readings on any time section using calibrated timebase settings.



5. When the waveform is too complex to properly set the cursors, better accuracy can be obtained by using delta-time delayed sweep.
Alternative timebase display mode allows you to view the total time-window and, at the same time, magnify signal detail for proper identification.



6. Triggerview can be used as an extra input channel, and also to verify proper trigger conditions.
Here, the trigger signal is obtained from channelA, and contains enough noise that it would make the display unstable and fuzzy.
Trigger selection is from channel A through HF reject.
Lower trace shows signal after filtering through HF reject.
Note that the trigger level is midscreen for easy reference and setup.



```
S E R V I C E - M E N U
TRIG VIEW -> IEEE-PARAMETERS
A ---------> UNIT-TESTS

 PM3296A     | UNIT  | VER | SUMCH
 SOFTWARE    | CPU   | 1.0 | 7487
             | CTU   | 1.1 | 2663
             | CHARG | 1.0 | ----
             | IEEE  | 1.0 | D2C4
AUTO SET --> EXIT SERVICE
```

7. The PM 3296A's extensive service menu facilitates performance check and calibration. Many adjustments can be performed by using internally generated signals to save calibration time.

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*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 3285A, PM 3286A, PM3295A & PM 3296A

Specifications

Technical Specifications

Autoset

Selects channel, amplitude, vertical position, timebase speed and triggering for surveyable display of input signal.

Display

CRT: Philips rectangular pda tube
Viewing Area: 8 x 10 cm
Acceleration Voltage: 24 kV (PM 3295/96A); 16.5 kV (PM 3285/86A)
Phosphor: Type GH (P31)
Readout: Alphanumerical display of relevant vertical and horizontal function selections, deflection coefficients and cursors.
Graticule: Internal with % indications for rise-time measurements. Illumination continuously variable.
Photographic Writing Speed:
4 cm/ns (PM 3295/96A);
2 cm/ns (PM 3285/86A),
with lens aperture F:1.2, object to image ratio: 1:0.5 and filmspeed 20,000 ASA.
External Z-Modulation: Positive voltage decreases intensity

Vertical Deflection

Sources: Y_A, Y_B, Trig view, Y_A and Y_B added. Y_A and Y_B can be inverted
Modes: Single channel or any combination of sources. Alternate or chopped. Display time in chopped mode 350 ns/channel.

Y_A and Y_B

Input Impedance (High Z): 1 MΩ in parallel with 9 pF
Input Impedance (50Ω): V.S.W.R.
1.3:1 at 400 MHz (PM 3295/96A);
1.2:1 at 200 MHz (PM 3285/86A)
Max. Input Voltage (High Z): 300V (DC + AC peak)
Max. Input Voltage (50Ω): 5 Vrms overload protected
Deflection Coefficient: 1 mV/div...5V/div (continuous control between steps)
Error Limit: 2%
Cursor Δt Error Limit: 2% overall

Frequency Response (pm 3295/96A):
DC...400 MHz (-3 dB) (15°C...35°C)
DC...350 MHz (-3 dB) (5°C...40°C)
In 1 mV/div and 2 mV/div settings: DC...70 MHz

Frequency Response (PM 3285/86A):
DC...200 MHz (-3 dB) (15°C...35°C)
DC...175 MHz (-3 dB) (5°C...40°C)
In 1 mV/div and 2 mV/div settings: DC...70 MHz

AC Coupled Lower -3 dB Point: 10 Hz

Rise Time*: .9 ns (PM 3295/96A);
1.75 ns (PM 3285/86A);
In 1 mV/div and 2 mV/div settings:
5 ns (PM 3295/96A);
5.4 ns (PM 3285/86A)
*Rise time calculated using $t_r = \dfrac{0.35}{\text{bandwidth}}$

Dynamic Range: 24 div up to 100 MHz
CMRR: 100:1 up to 1 MHz; 20:1 up to 50 MHz
Visual Signal Delay: 20 ns
Bandwidth Limiter: Reduces bandwidth to 20 MHz (-3 dB)

Trigger View

Deflection Coefficient: Via EXT. input 100 mV/div or 1V/div; Via Y_A or Y_B 1 mV/div...5V/div
Frequency Response (PM 3295/96A):
Via EXT input: DC...370 MHz (-3 dB);
Via Y_A or Y_B: DC...350 MHz (-3 dB)
Frequency Response (PM 3285/86A):
Via EXT input: DC...200 MHz (-3 dB);
Via Y_A or Y_B: DC...150 MHz (-3 dB)
Delay Between EXT. Input and Y_A or Y_B: 2 ns

Horizontal Deflection

Display Sources: MTB, MTB intensified by single or dual DTB, DTB, MTB and DTB Alternate, EXT., Line. Trace separation between MTB and DTB in ALT mode continuously controllable over at least 4 divisions

Main Time Base

Modes: AUTO, Trig., Single
Deflection Coefficient: 1s/div...10 ns/div (PM 3295/96A);
1s/div...20 ns/div (PM 3285/86A)
(continuous control between steps)
Error Limit: 0.5% of full scale + 1% of reading
Cursor Δt: Error limit 0.5% of full scale + 1% of reading
Frequency Readout: 1/Δt
Time Base Magnifier: x 10 fastest sweep...
...1 ns/div (PM 3295/96A)
...2 ns/div (PM 3285/86A)
Error Limit: 1% of full scale + 1.5% of reading
Variable Hold Off: Up to 10 x min. value

Delayed Time Base

Modes: Starts immediately after delay time or upon first trigger after delay time
Deflection Coefficient:
0.5s/div...10 ns/div (PM 3295/96A);
0.5s/div...20 ns/div (PM 3285/86A)
(continuous control between steps)
Error Limit: 0.5% of full scale + 1% of reading
Time Base Magnifier: x 10 fastest sweep...
...1 ns/div (PM 3295/96A)
...2 ns/div (PM 3285/86A)
Error Limit: 1% of full scale + 1.5% of reading
Delay Time: 20 ns...10s
Error Limit: 1.2% of full scale + 1% of reading + 12 ns
Time Interval (Δt):
10 ns...10s (PM 3295/96A)
20 ns...10s (PM 3285/86A)
Error Limit: 0.1% of full scale + 0.5% of reading + 2 ns
Frequency Readout: 1/t
Resolution of Delay Time or Δt Control: 1:65,000
Jitter: 1:20,000

Triggering MTB Sources: YA, YB, Composite, EXT, EXT ÷ 10, Line
Coupling: DC, AC, LF REJ, HF REJ
Slope: + or -

Level Range:
Internal: +8...-8 div.
EXT: +0.8...-0.8V
EXT ÷ 10: +8V...-8V
Trigger level is read out on screen if instrument is equipped with GPIB IEEE interface. Standard on PM 3286A/PM 3296A

Triggering Sensitivity

	PM 3295/96A	
	up to 100 MHz	up to 400 MHz
INT	0.5 div.	2 div.
EXT	50 mV	300 mV
EXT ÷ 10	500 mV	3V

	PM 3285/86A		
	up to 100 MHz	up to 200 MHz	up to 250 MHz
INT	0.5 div.	1 div.	—
EXT	50 mV	—	300 mV
EXT ÷ 10	500 mV	—	3V

Triggering DTB: See MTB triggering except for Line triggering

External

Sources: Y_A, Y_B, EXT
Input Impedance Via EXT: 1 MΩ in parallel with 9 pF
Deflection Coefficient Via EXT: 100 mV/div or 1V/div
Frequency Response: DC...2 MHz (3 dB)
Phase Difference Between Y and EXT: 3° up to 100 kHz
Line: 7 div for frequencies of 50 Hz...60 Hz

Signal Outputs

Calibration Voltage: Square wave, positive going
Amplitude: 0.8V ±1%
Frequency: 5 kHz ±0.1%
Impedance: 50Ω ±1%
Y Signal: Selectable via DTB trigger source
Amplitude: 20 mV/div into 1 MΩ; 10 mV/div into 50Ω
Range: 160 MV$_{p-p}$ into 1 MΩ; 80 mV$_{p-p}$ into 50Ω
Frequency: DC...300 MHz (-3 dB) (PM 3295/96A);
DC...200 MHz (-3 dB) (PM 3285/86A)
MTB Gate: TTL compatible
DTB Gate: TTL compatible

Cursors

Voltage Cursors
Cursor Range: Center 7 divisions
Ratio Range: 0.1%...999%; 100% reference at any amplitude

Timer Cursors
Cursor Range: Center 9 divisions
Ratio Range: 0.1%...999%; 100% reference at any time difference

PM 3285A, PM 3286A, PM3295A & PM 3296A

GPIB/IEEE-488 Interface

All functions (except CRT controls) can be controlled or read by a controller via GPIB/IEEE-488 interface bus. GPIB/IEEE address and talker/listener functions can be set by front panel switches in service menu mode. In remote mode front panel is locked (remote LED on) or unlocked (remote LED blinking) by program. In unlocked mode SRQ function is available via AUTOSET.

Power

Voltage Range: 90...264 VAC, one range
Frequency Range: 45...440 Hz
Consumption: 136W
Battery Back-Up: Holds front panel setting when instrument is switched off
Retention Time: 2 years

Environmental Capabilities

The instrument meets the requirements of MIL-T-28800C, type III, class 5, style D.

Temperature
Operating: 0...50°C
Storage: -40...+75°C
Humidity: 95% R.H.

Altitude
Operating: 4.5 km (15,000 ft)
Storage: 12 km (50,000 ft)

Vibration
Frequency Range: 5 Hz...55 Hz
Max. Acceleration: 3g at 55 Hz held 10 min. at each resonance frequency
Shock: 6 shocks each axis, half sine wave pulse, 11 ms duration, peak acceleration 30g
Bench Handling: MIL-STD 810, method 516, procedure V
EMI: MIL-STD 461 class B, VDE 0871, VDE 875 Grenzwert Klasse B
Safety: The instrument meets the requirements of IEC 348 class I, VDE 411, UL 1244, CSA 556B

Mechanical

Height: Without feet and accessory pouch; 170 mm H (6.7 in)
Incl. feet and accessory pouch: 240 mm (9.4 in)
Width: Incl. feet and accessory pouch: 340 mm (13.4 in)
Depth (excl. handle):
PM 3295/96A: 523 mm (20.6 in)
PM 3285/86A: 473 mm (18.6 in)
Depth (incl. handle);
PM 3295/96A: 625 mm (24.6 in)
PM 3285/86A: 575 mm (22.6 in)
Weight:
PM 3295/96A: 13.9 kg (30.7 lbs)
PM 3285/86A: 13.6 kg (30 lb)

Setting Memory (PM 3296A and PM 3286A)
Memory Capacity: up to 75 front panel settings

Infrared Remote Control
Functions: RECALL, NEXT, PREVIOUS...for recall of programmed settings.
Special functions for protection of programmed settings and identification of instruments.
AUTO...for automatic setting-up of front panel for surveyable display of any input signal.
Transmission Type: Infrared
Batteries: 4 x AAA lifetime typically 2 years
Transmission Distance: Typically 10 ft. (3.5m)
Dimensions: 71 mm W x 16 mm H x 173 mm L (2.6 in W x 0.6 in H x 6.8 in L)
Weight: 135g (0.3 lbs)

Environmental Characteristics
Operating Temp. Range: +5...45°C
Storage Temp. Range: -25...+70°C (without batteries)
Unit is splash-proof; no functional failure after drying period of 24 hrs.

Included with the Instrument:
2 x 10:1 passive probes 1m (3 ft) (PM 3295/96A), 2 x 10:1 passive probes 1.5m (5 ft) (PM 3285/86A), Collapsible viewing hood, Blue contrast filter, Front cover, Operating Manual

Ordering Information

Models

January 1989 prices

PM 3285A 200 MHz Oscilloscope	$4400
PM 3286A as above, with 75 menu memory and IR remote control	4950
PM 3295A 400 MHz Oscilloscope	5350
PM 3296A as above, with 75 menu memory and IR remote control	5900

Optional Configurations

When ordering, select the basic "PM" model from above, and add the configuration option number listed below as a suffix.

/003 Basic model, bench/portable configuration (PM 3285A, PM 3295A)	N/C
/303 19" Rackmount version (PM 3285A, PM 3295A)	add 275
/403 Basic model, bench/portable configuration (PM 3285A, PM 3295A), with GPIB IEEE-488	add 400
(PM 3286A, PM 3296A), with GPIB IEEE-488	N/C
/803 19" Rackmount version (PM 3285A, PM 3295A), with GPIB IEEE-488	add 675
(PM 3286A, PM 3296A), with GPIB IEEE-488	add 275

Example, Ordering Information
To order a 400 MHz oscilloscope in bench top/portable configuration, with GPIB/IEEE-488, select:

	Model	Price
Basic Oscilloscope	PM 3295A	$5350
Configuration Option Suffix	/403	400
Complete model number	PM 3295A/403	5750

Accessories (Also see page 53)

Passive Probes

PM 8911/09 500Ω, 10:1 Passive Probe with readout, cable length 3 ft (1m)	$125
PM 8912/09 5 kΩ, 100:1 Passive Probe with readout, cable length 3 ft (1m)	125
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8929/09 10:1 Passive Probe with readout, cable length 5 ft (1.5m)	90
PM 8929/19 10:1 Passive Probe with readout, cable length 3 ft (1m)	90
PM 8929/29 10:1 Passive Probe with readout, cable length 8 ft (2.5m)	90
PM 8931/09 20 MΩ, 100:1 Passive Probe with readout	135
PM 9599/09 Set of VHF Attenuators	200

Active Probes

PM 8940/09Q High Voltage Isolation Amplifier with readout	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe with readout	1000

Other Accessories

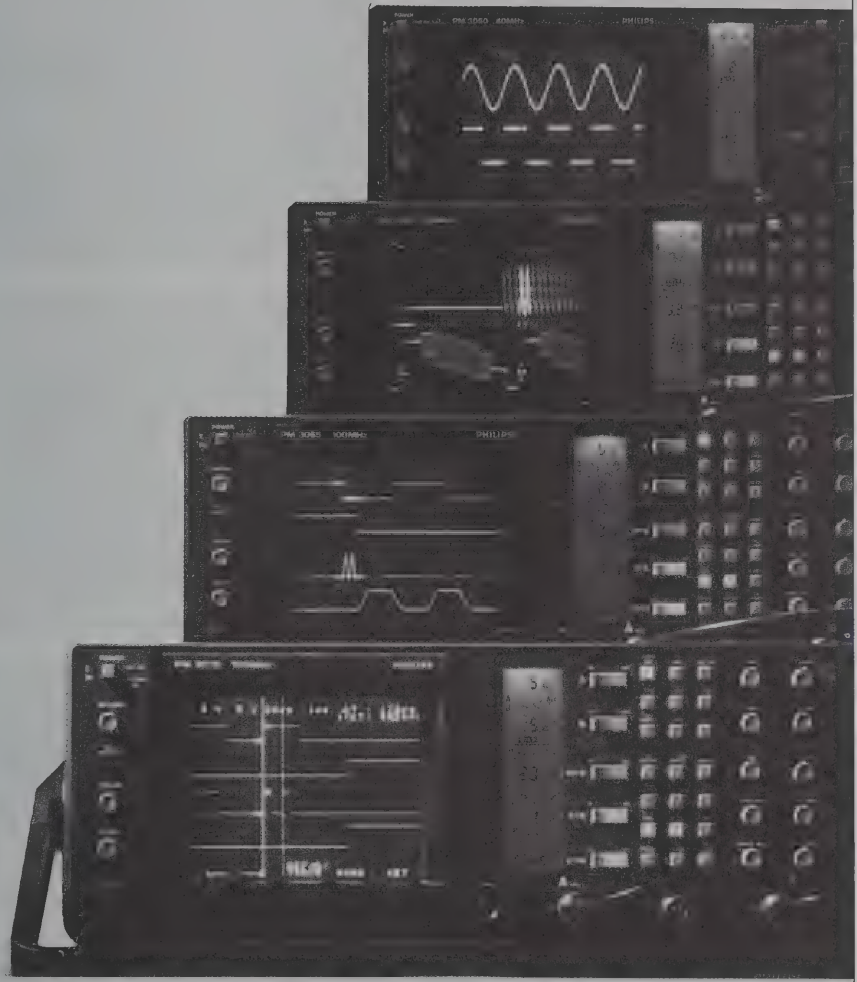
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9310/00 Collapsible Viewing Hood	12
PM 9311/00 Long Viewing Hood	85
PM 9381 Oscilloscope Camera	650
PM 9877/00 Camera Adapter for stationary use	150
PM 8991/04 Oscilloscope Cart	450
PM 8992/80 Accessory Pouch	45
PM 8950/951 Service installable Retrofit Kit for GPIB IEEE-488	750
PM 8917/003 Video Sync Separator and Line Selector	550
PM 2195/09 GPIB controlled Probe Switch 400 MHz	650
PM 2240/001 TestTeam Software	925

Service and Support

Three-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3050, PM 3055, PM 3065 & PM 3070



PM 3050, PM 3055, PM 3065, PM 3070

PM 3050/55 60 MHz & PM 3065/70 100 MHz Oscilloscopes
AUTOSET for automatic amplitude,time,and trigger setting
LCD panel displays status and settings
16 KV crt acceleration voltage
Fast action up/down controls and cold switching
GPIB/IEEE-488 interface option
Single timebase, dual timebase and cursor versions

The New 60/100 MHz Standards

The PM 3050 to PM 3070 series of oscilloscopes set new standards in the 60 to 100 MHz oscilloscope range. A new standard in convenience and ease of use together with a new price/performance standard for instruments of this class.

The series consists of four models which are all optionally available in rackmount versions for systems use. These are;

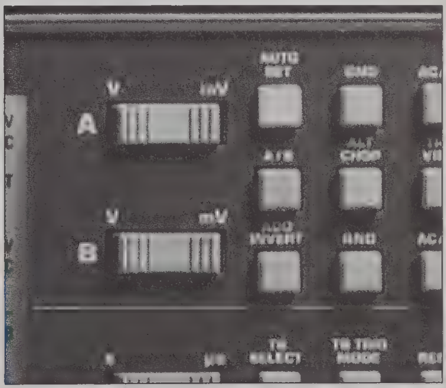
- PM 3050 60 MHz 2 channel, single time base
- PM 3055 60 MHz 2+1 channel, dual time base
- PM 3065 100 MHz 2+1 channel, dual time base
- PM 3070 100 MHz 2+1 channel, dual time base with clever cursors

Each unit represents a significant step forwards in 'scope technology through their use of microcomputer control to both speed up and simplify the task of signal measurements.

Standard features in all models include AUTOSET for single push button set up; a large backlit LCD showing all operating parameters; fast up/down rocker keys and cold switching for high reliability.

Measurements In Seconds

Just press the green AUTOSET button and automatic setting of channel amplitude, time base sweep speed and triggering takes place, for any signal. If only one channel is connected only one channel is displayed but if both channels are being used then both are automatically scaled and displayed. Triggering takes place on the lower frequency channel to give a clear jitter free display. AUTOSET eliminates time consuming manual range finding and adjustment to give fast accurate results at the touch of one button.



Just press the green AUTOSET button and automatic setting of channel amplitude, time base, sweep speed and triggering takes place, for any signal.

PM 3050, PM 3055, PM 3065 & PM 3070

Clean and Simple Operation.

With up/down rocker keys for amplitude and time base speed selection and pushbuttons for display mode and trigger source selection the operation of this series of oscilloscopes is kept clean and simple. Upon each user action the backlit LCD display is immediately updated making at a glance review of the 'scopes current parameter settings possible rather than having to search the complete front panel to determine the operating conditions.

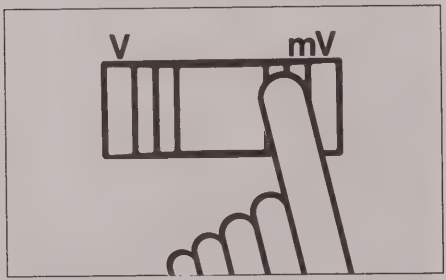
The internal microcomputer prevents illegal setups like incorrect main and delayed timebase settings and clearly identifies on the display non-calibrated amplitude settings or grounded inputs. This avoids incorrect measurements, wasted time and frustration.

To speed accurate measurements when using the delayed time base, the LCD gives a digital readout of the delay time so making the calculation of MTB sweep speed x delay time vernier redundant. For infrequent 'scope users the MENU key functions as a 'help' key showing the facilities offered by each key on the 'scope and quickly aquainting the user with its operation.

High Reliability and Easy Service

Behind the push button operation all input signals are switched by hermatically sealed long life reed relays. These keep out damp and dirt from the active signal paths and ensure long life and long term measurement stability.

The advanced modular construction of these 'scopes allows complete functional testing of each subassembly before they are built together to form a complete instrument. An extended burn in period lasting 48 hours then follows before another series of extensive tests takes place. This ensures that zero hour defects are almost completely eliminated and results in long term trouble free operation. In the unlikely event that a failure should occur the modular construction enables easy access to the suspect board without major disassembly.

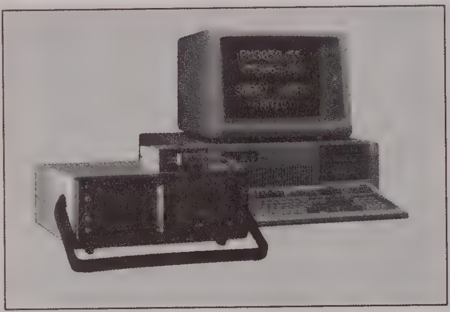


Advanced CRT

With 16 KV acceleration and advanced electron optics the CRT display has exceptional brilliance combined with a small spot size making it ideal for measurements on high speed or low repetition rate signals. The effective screen area is a full 8 x 10 cm. An internally etched graticule is provided for accurate and parallax-free measurements. Graticule illumination is standard on all models.

Fast Computer Hook Up

For systems use this Smart Scope series can be simply controlled by the GPIB/IEEE-488* bus using the PM 8953A interface. This retrofittable interface enables the 'scopes to be automatically set up for production testing or QA applications.

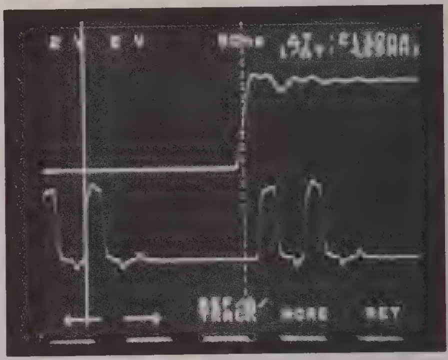


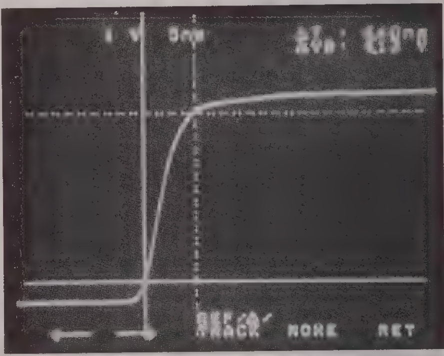
As the PM 8953A IEEE-488 interface is a separate unit which simply plugs onto the rear of the 'scope it is extremely interesting for fleet owners as it permits automatic IEEE based recalibration of the complete fleet with only one interface needing to be purchased, so saving time in recalibration, and money as well.

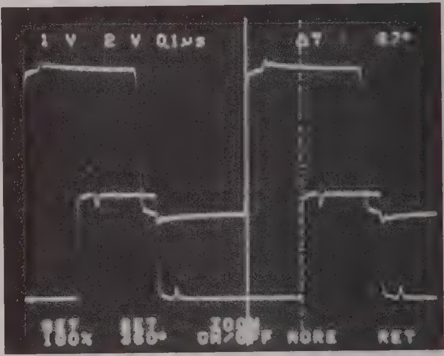
Clever Cursors

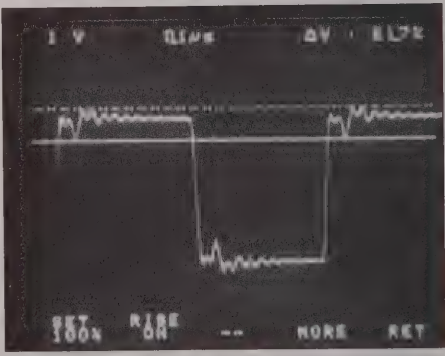
The PM 3070 offers full cursor measurement capabilities in both time and amplitude axes. Control of all cursor functions is by five keys in the bezel of the CRT which also are used to independently control the intensity of the alphanumerics and the cursor intensity. Accurate measurements of peak-peak values, voltage ratios, rise times, phase relationships and time ratios are possible with direct numerical display on the CRT.

A special facility called the ZOOM function enables the signal between the cursors to be expanded to fill the full width of the screen by automatically adjusting the delay time and delay time base speed. This makes it easy to zoom in on a particular point of interest without having to consider how to set up the delay time section. In addition to the measured data both channel and time base status is displayed on screen and user text or messages can also be specified.





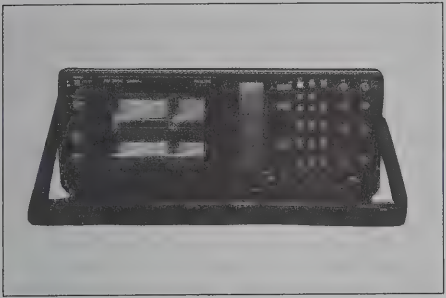




**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

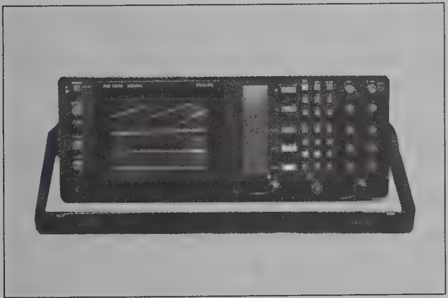
PM 3050, PM 3055, PM 3065 & PM 3070

PM 3050 60 MHz 2 Channels, SingleTime Base



With all the standard facilities of the Smart Scope series this basic instrument provides comprehensive trigger facilities like TV line, TV frame, Peak-Peak Auto and DC coupling in addition to trigger hold off. Time base speeds to 5 nsec per division are standard as well as x 1 and x 10 probe identification. X deflection via either channel is possible.

PM 3055 60 MHz 2+1 Channels, Dual Time Base

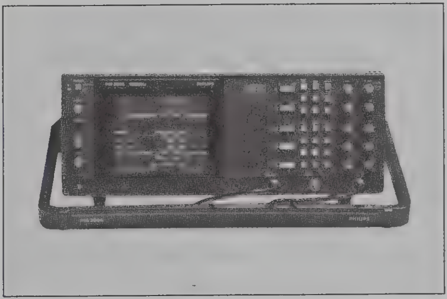


PM 3055 60 MHz oscilloscope with delayed time base and third channel trigger view.

The external trigger input of this 'scope doubles as a third input channel with a fixed attenuation. The Delayed Time Base facility can be directly triggered from the main time base or from either input channel. Display of MTB intensified and DTB is possible at the same time or independently.

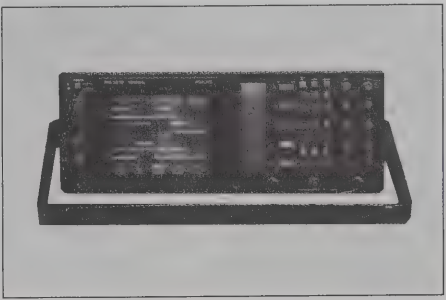
PM 3065 100 MHz 2+1 Channels, Dual Time Base

Triggering to 150 MHz plus the high intensity CRT makes this unit the ideal general purpose workhorse.The fast 3.5 nsec rise time and good pulse response characteristics make the PM 3065 the ultimate 100 MHz oscilloscope.



PM 3065 100 MHz oscilloscope with delayed time base and third channel trigger view.

PM 3070 100 MHz 2+1 Channels, Dual Time Base, Clever Cursors



PM 3070 100 MHz delayed sweep oscilloscope with clever cursors.

The Clever Cursors provide both amplitude and time measurement capabilities. In the amplitude mode peak-peak, ratio and 10% and 90% levels (for rise times) can be read directly from the display.

In the time mode rise times, ratio and phase measurements can be made and read from the display. In addition the ZOOM facility enables fast pinpointing and expansion of a specific section of the measured signal.

Specifications

Technical Specifications

Display: CRT 8 x 10 cm viewing area, P31 phosphor, 16 kV acceleration voltage. Parallax-free graticule with continuously variable illumination. Separate LCD for display of menus, settings, status indications etc. LCD is constantly illuminated by backlighting.

AUTOSET

Autoset selects proper channel, sets vertical deflection, timebase speed and triggering for easy-to-read display of input signals.

Vertical Deflection

Display Modes: Ya, Yb, - Yb, Ya + Yb, Ya - Yb, Yb

Trigger View: In any combination, chopped or alternate (not PM 3050).

Frequency Response

PM 3065/70: DC...>100 MHz -3 dB

PM 3050/55: DC...>60 MHz -3 dB (0...35°C) (20 mV/div...10 V/div)
DC...>35 MHz -3 dB (2 mV/div...10 mV/div)

In AC Mode: Lower -3 dB point is <10 Hz

Rise Time

PM 3065/70: <3.5 ns

PM 3050/55: <6 ns (20 mV/div...10 V/div) <10 ns (2 mV/div...10 mV/div)

Deflection Coefficient: 2 mV/div...10 V/div in steps of 1, 2, 5 sequence

Error Limit: 3%

Continuous control between steps with > flashing in LCD as warning symbol for uncal. amplitude.

Input Impedance: 1 MΩ± 2%//20 pF ± 2 pF

Max. Rated Input Voltage: 400V (DC + AC peak)

Dynamic Range: >24 div. at 10 MHz > 8 div. at 100 MHz (PM 3065/70); 50 MHz (PM 3050/55)

CMRR: 100:1 at 1 MHz

Trigger View

Frequency Response:

PM 3065/70: DC...>100 MHz -3 dB (via ext)
DC...>75 MHz -3 dB (via Y_A or Y_B)

PM 3050/55: DC...> -3 dB (via ext 0...35°C)
DC...>50 MHz -3 dB (via Y_A or Y_B)

Deflection Coefficient: 100 mV/div. via Ext. Input 2 mV/div...10 V/div. via Ya or Yb

Horizontal Display Modes

PM 3055/65/70: MTB, MTBI, Alt TB, DTB, X-defl.

PM 3050: TB, X-defl.

Main Timebase (MTB) or Timebase (TB)

Time Coefficients: 0.5 s/div...50 ns/div. in steps of 1, 2, 5 sequence

Magnifier: x 10

Fastest Sweep Speed: 5 ns/div

Error Limit: 3%

Error Limit Magn. Sweep: 4%

Continuous control between steps with > flashing in LCD as warning symbol for uncal. sweep.

Hold-off: Continuously adjustable up to 10 x min. value

Delayed Timebase (DTB)
(not on PM 3050)

Time Coefficient: 1 ms/div...50 ns/div. in steps of 1, 2, 5 sequence

Magnifier: x 10

Fastest Sweep Speed: 5 ns/div

Error Limit: 3%

Error Limit Magn. Sweep: 4%

Trace Separation: >±4 div. DTB shift only

Delay Timebase Multiplier (DTM)
(not on PM 3050)

Resolution: 1:10,000

Error Limit Total: 4%

Delay Time Jitter: 1 ÷ 20,000

PM 3050, PM 3055, PM 3065 & PM 3070

Triggering (MTB or TB)

Trigger Modes: Auto (free run), Non Auto Triggered, Single
Trigger Sources: A, B Composite (A, B), Ext. (DC or AC), Line
LCD indicates Not triggered, Triggered or Armed status
Trigger Coupling: Peak-to-peak (P-P), DC, TVL, TVF

Triggering (DTB) (not PM 3050)

Starts, A, B, Composite (A, B), Ext. TVL (only if MTB TV selected)

Trigger Sensitivity

PM 3050/55		
	Int.	Ext.
10 MHz	0.5 div	50 mV
50 MHz	1 div	150 mV
100 MHz	3 div	500 mV
TVF/TVL	0.7 div sync.	70 mV sync.
Level range	±8 div	±800 mV

PM 3065/70		
	Int.	Ext.
10 MHz	0.5 div	50 mV
100 MHz	1.2 div	150 mV
150 MHz	2 div	500 mV
TVL/TVF	0.7 div sync.	70 mV sync.
Level range	±8 div	±800 mV

Slope pos. (_/¯), or neg. (¯_), TVF or TVL pos. (+) or neg. (-)

X-Deflection

Deflection Coefficient: Via channel A or B 2 mV/div...10 V/div.
via Ext. input 100 mV/div
Frequency Response: DC...2 MHz
Error Limit: 5%
Phase Shift: <3° (at 100 kHz)
Ext. Input: 1 MΩ ±2%//20 pF ±2 pF
Max. Input Voltage: 400V (DC + AC peak)

Cursor Measurements PM 3070
Features: V, t, 1/t
Ratio
Phase
Rise Time (4 way cursors)
Zoom
User text
Settings read-out
Intensity control independent of trace

Output Options

Y Signal out from Channel A (Not PM 3065/70)
Deflection Coefficient: 100 mV/div.; load 10 kohm 40 m/div.; load 508

Frequency Response
PM 3050/55: >60 MHz -3 dB
MTB Sweep Out: Output voltage 0.5 V/div; load 1 MΩ
MTB Gate Out: High when running MTB sweep; otherwise low; voltage output high > 2.4v; low <0.4V
DTB Gate Out: High when running MTB sweep; otherwise low; voltage output high >2.4V; low <0.4V

Check the comprehensive range of system oriented accessories for the PM 3065/PM 3070 to specify exactly the configuration you need. These options add extra functions, convenience and transportability to everyday work with your oscilloscope.

General Specifications

Power Supply

Safety requirements meet following specifications: IEC 348 Class I, UL 1244, CSA 556B, VDE 0411
Line Voltage: 100...240V ±10% in one range
Line Frequency: 50...400 Hz ±10%
DC Nominal Voltage: 145...335V

Power Consumption (AC source)
PM 3050/55: 50W
PM 3065/70: 60W

Miscellaneous
Cal. Output: 1.2V ±1%
Frequency: 2 KHz
Z-modulation Input: TTL-compatible
>2.0V blanks display
<0.8 max. intensity, analog control possible between 2.0V and 0.8V

Mechanical Data

Width
Incl. Handle: 387 mm (15.2 in)
Excl. Handle: 350 mm (13.8 in)

Length
Incl. Handle, Excl. Knobs: 518 mm (20.4 in)
Excl. Handle and Knobs: 433.5 mm (17.1 in)
Incl. Handle and Knobs: 530.5 mm (20.9 in)
Excl. Handle, Incl. Knobs: 455.7 mm (17.9 in)

Height
Incl. Feet: 146.5 m (5.8 in)
Excl. Feet: 134.5 mm (5.3 in)
Excl. Lower Cabinet: 132.5 mm (5.2 in)
Weight: Approx. 7.5 kg (16.5 lb) excl. access.

Environmental Data

Temperature
Rated Range of Use: +10°C...+40°C
Limited Range of Operation: 0°C...+50°C
Storage: -40°C...+75°C

Altitude
Operating: 15,000 ft (4,500 m)
Non-Operating: 40,000 ft (12,000 m)
Humidity: 95% RH
EMI: Meets requirements of MIL-STD-461 Class B, VDE 0871 and VDE 0875 Grenzwert- klasse B

Shock
Operating and Non-operating: 30g, 1/2 sine, 11 ms duration, 6 shocks in each direction (3 each face), for a total of 18 shocks
Vibration: 5...55 Hz, 15 minutes along each of three axes, with a maximum acceleration of 3g. Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found
Bench Handling: MIL-STD-810, method 516, procedure V
The PM 3050/55/65/70 are designed to meet the requirements of MIL-T-28800 D, Type III, Class 5, Style D.
Included with instrument: 1 set 100 MHz, 10:1 probes with 5 ft. (1.5m) cable and scale factor readout (unless noted); Blue CRT contrast filter; Operating Manual

Ordering Information

Models

January 1989 prices

PM 3050 60 MHz Oscilloscope	$1150
PM 3052 same, with Rackmount	1275
PM 3055 60 MHz Oscilloscope with 2+1 channels and delayed sweep	1350
PM 3057 same, with Rackmount	1475
PM 3065 100 MHz Oscilloscope with 2+1 channels and delayed sweep	1645
PM 3067 same with Rackmount	1770
PM 3070 100 MHz Oscilloscope with 2+1 channels, cursors and delayed sweep	1895
PM 3072 same, with Rackmount	2020

Optional Configurations

When ordering, select basic "PM" Model desired from above, and add the configuration option number listed below as a suffix.

/003 Basic Oscilloscope as listed above	N/C
/003B Basic Oscilloscope w/PM 8926 probes (only available on 60 MHz models)	less 55
/113 CRT with P7 long persistence phosphor	add 40
/703 Y Signal Output (only available on 60 MHz models)	add 75
/743 MTB Sweep + MTB gate + DTB gate outputs	add 75
/753 MTB Sweep + MTB gate + DTB gate outputs, P7 phosphor	add 115
/763 Y Signal Output (only available on 60 MHz models), plus MTB gate + DTB gate outputs	add 150
/773 Y Signal Output (only available on 60 MHz models), plus MTB gate + DTB gate outputs, P7 CRT	add 190

PM 3050, PM 3055, PM 3065 & PM 3070

Example, Ordering Configuration

To order the 60 MHz, dual timebase oscilloscope in a rackmount configuration with MTB Sweep + MTB Gate + DTB Gate Out:

	Model	Price
Oscilloscope	PM 3072	$2020
Configuration Option Suffix	/743	75
Complete Model Number	PM 3072/743	2095

Accessories (See page 53)

Passive Probes

PM 8922/501 1:1 10:1 Probe, cable length 4 ft. (1.2m)	$ 50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8924/20 1:1 Probe, cable length 8 ft (2.5m)	60
PM 8926 10:1 Passive Probe, cable length 5 ft (1.5m)	70
PM 8926/09 10:1 Passive Probe with readout, cable length 5 ft (1.5m)	80
PM 8926/501 10:1 Probe, cable length 4 ft (1.2m)	$50
PM 8926/591 10:1 Probe with readout, cable length 4 ft (1.2m)	60
PM 8926/29 10:1 Passive Probe with readout, cable length 8ft (2.5m)	80
PM 8931/09 20 MΩ, 100:1 Passive Probe with readout	135
PM 8936/09 Set of 2 PM 8926/09	125

Active Probes

PM 8940/09Q High Voltage Isolation Amplifier with readout	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe with readout	1000

Other Accessories

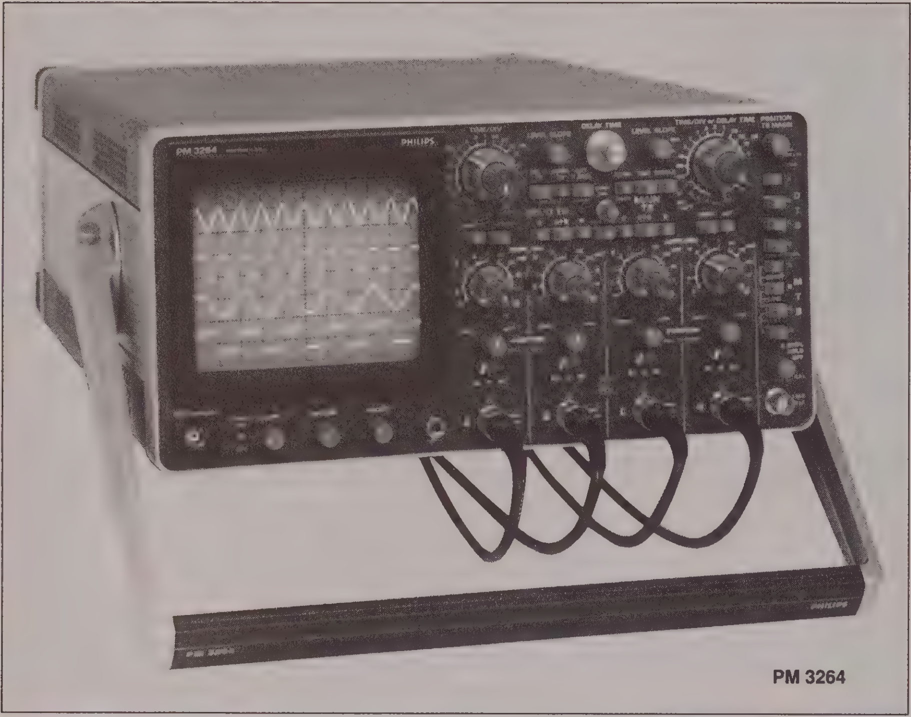
PM 8901Q Rechargeable Battery Pack	1275
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8953A External, retrofittable GPIB IEEE-488 I/F	$550
PM 8988 Protective Front Panel Cover	35
PM 8991/04 Oscilloscope Cart	450
PM 8999 Oscilloscope Stand	250
PM 8992/80 Accessory Pouch	45
PM 8998 Front panel memory for PM 3050...70	75
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9381 Oscilloscope Camera	650
PM 2195/09 Probe switch	650
PM 2122/01 50Ω Coaxial Switch	680

Service & Support

Three year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3264



PM 3264

PM 3264 100 MHz Four-Channel Oscilloscope

- Fifth channel trigger view
- Advanced display facilities for realtime analysis up to 100 MHz
- Multi-source triggering
- Simultaneous display of MTB and DTB
- Portable with battery operation for field use

The PM 3264 offers a unique solution to many timing problems in digital electronics. Simultaneous display of 4 or 5 input signals provides a quick and convenient method for realtime analysis of digital signals both at component and system level.

A versatile deflection system provides many user-benefits. For example, any combination of up to five input signals and two different modes can be selected by push-buttons. The sensitivity of the channels includes 2 mV/div up to 400V per screen, using the standard 1:10 attenuator probes.

A flexible triggering system allows the main and delayed time bases to be triggered independently by any of the four input channels. Also, an external trigger and composite trigger are provided.

The alternate time base facility permits a quick reference for magnified displays with respect to the original waveform. The multiple trace display demands a CRT with very high light output. Philips has designed a special tube with 17 kV pda which provides a more-than-adequate sharp, bright, spot.

With all the foregoing facilities, the PM 3264 remains a typically compact, portable, oscilloscope which is also extremely simple to use. The various facilities are summarized as follows:

- Four channels to show signal relationships in time
- Multi-source triggering to add display flexibility
- Trigger-view to relate triggering directly to the four-channel display
- Other features like differential displays and composite triggering to extend performance
- Two time bases to allow signal detail to be packed out from the data stream
- Alternative time base mode to allow signal details to be directly related to data stream

Moreover, facilities can be permutated, with virtually no limitation. For example, main and delayed time bases can be independently triggered from any of the four channels. Or the alternate time base mode can be employed with a differential display and the original four channels to give a 12-trace display.

Trigger View

PM 3264 features the ultimate in multi-sourced triggering, with independent selection of main and delayed time bases from any of the four channels plus composite, line and external triggering on the main time base. It is therefore essential that the relationship between the various displays and the triggering signal is always clear and this is provided by the trigger view facility. At the touch of a button the actual trigger signal is displayed as a “fifth” channel, so that there can be no possibility of display ambiguity.

Alternate Time Base Mode

This mode is obtained simply by pushing both the main and delayed time base controls together. It enables the delayed time base signal details to be displayed at the same time as the intensified main time base signals. In this way signal details can be directly related to the data stream.

X-Y Displays

X-Y displays are further evidence of the advanced display capability of the PM 3264. The independent triggering facilities allow any one of four channels to be displayed against an X-input signal or against any of the four vertical input.

Composite Triggering

Single-channel triggering shows the exact relationship between the displayed signals. Composite triggering, however, allows signals that are not related in time or phase to be displayed and compared. This facility can be used in a variety of ways, for example rise times or waveform aberrations can be compared and measured regardless of the time span between signals or the frequency relationship.

Logic Triggering Too

The PM 3264 is the ideal compliment to a logic analyzer since it shows realtime relationships and signal details, such as glitches, in their actual analog waveform.

Very Easy Operation

PM 3264 is a highly sophisticated instrument but the front panel could not possibly be simpler or more logical. Channel selection is made, for example, directly above the relevant channel controls. Trigger selection for main and delayed time bases is also logically grouped. This simplifies and speeds up measurements and allows the oscilloscope to be used for virtually all applications and production testing.

In addition the PM 3264 is light, easy to transport and hence ideal for field work, a facility that can be extended via the optional battery pack.

PM 3264

Specifications

Technical Specifications

CRT

Type: Philips rectangular domed mesh-type tube with 17 kV acceleration potential and metal-backed phosphor
Screen Type: P31 (GH phosphor standard)
Useful Screen Area: 8 x 10 div. of full centimeters
Graticule: Internal graticule with centimeter divisions and 2 mm subdivisions along the central axes. 10% and 90% lines are indicated. Illumination continuously variable.

Vertical or Y-Axis, Channels A thru D

Response
DC: 0 Hz...100 MHz (35 MHz at 2 mV)
AC: 7 Hz...100 MHz
Rise Time: 3.5 ns
Deflection Coefficients: 2 mV...5V/div. in steps in 1-2-5 sequence. Uncalibrated continuous control between steps 1: >2.5
Display Modes: Channel A, B, C or D; A + B, C + D; Trigger view; Any combination of these channels.
Multiple display chopped at 1 MHz or alternate. Any channel may be inverted except Trigger view.
CMMR: >100:1 up to 2 MHz; >20:1 at 50 MHz
Input Impedance: 1 MΩ ±2% in parallel with 15 pF approx. RC time, AC coupled: 22 ms
Maximum Input Voltage: $400V_{DC} + AC_{pk}$, derating above 500 kHz
Maximum Deflection: Undistorted deflection of 24 div. up to 35 MHz Shift range 16 div.
Signal Delay: 15 ns visible delay

Trigger View
Display: External or internal trigger signal
Deflection Coefficient External: 100 mV/div
Trigger Point: Screen center ±0.3 div.
Time Delay Between Vertical Input and External Input: 3 ns

Horizontal or X-Axis

Horizontal deflection can be obtained from either the main time base or the delayed time base or a combination of the two, or from the signal source selected for X-deflection.
In this case X-Y diagrams can be displayed using A, B, C, or D the Ext connector or the Line as a signal source.

Horizontal Display Modes:
- Main time base
- Main time base intensified by delayed time base
- Delayed time base
- Main time base and delayed time base simultaneously displayed (alternate)
- X-Y operation with X-deflection by A, B, C, D line or Ext source

Horizontal Amplifier

Response: DC...2 MHz (-3 dB)
Deflection Coefficient: 50 mV/div. using EXT connector. Uncalibrated continuous control 1: >3. When A, B, C, or D are used, sensitivity is 2 mV...5V/div.
Measuring Accuracy: ±3%
Phase Error: 3° at 100 kHz

Main Time Base Modes

- Auto
- Triggered (RC time 100 ms)
- Single shot

Time Coefficient: 1s...50 ns/div. in 23 calibrated steps, in 1-2-5 sequence. Uncalibrated continuous control between steps (with UNCAL warning lamp should delayed time base be set out of calibration). x 10 magnifier extends max. sweep rate to 5 ns/div.
Accuracy: ±2% (+20°C...+30°C); ±3% (+5°C...+40°C); Additional error for magnifier ±1%
Variable Hold-Off: Sweep hold-off time can be increased by a factor of 10

Delayed Time Base

Modes: Delayed time base starts, either immediately after the delay time or, upon arrival of the first trigger pulse after the delay time.
Time Coefficients: 0.5s...50 ns/div. in 22 calibrated steps, 1-2-5 sequence. Uncalibrated continuous control between steps, (with UNCAL warning lamp should main time base be set out of calibration). x 10 magnifier extends max. sweep rate to 5 ns/div.
Accuracy: ±2% (+20°C...+30°C); ±3% (+5°C...+40°C); Additional error for magnifier ±1%
Calibrated Sweep Delay: Continuous calibrated control between 0 and 10 x main time base setting
Incremental Delay Time Accuracy: 0.2% typical
Delay Time Jitter: Better than 1:30 000

Main Time Base Triggering

Trigger Source: Internal A, B, C, D Composite, line External
Slope: + or -
Level Range: Internal: 24 div.
External: +1.2V to -1.2V

Trigger Sensitivity

	30 MHz	100 MHz
Int	0.5 div	1.5 div
Ext	50 mV	150 mV

Trigger Coupling
DC: DC...full bandwidth
AC: 100 Hz...full bandwidth
Ext. Trigger Input Impedance: 1 MΩ ±2% in parallel with 15 pF approx.
Maximum Allowable Input Voltage: $400V_{DC} + AC_{pk}$
Trigger Jitter: Better than 0.5 ns

Delayed Time Base Triggering

Trigger Source: Internal: A, B, C, or D; For Slope, Level range and Sensitivity see Main Time Base Triggering

Calibration

Calibrated Voltage: $3V_{p-p}$ ±1% square wave
Calibrated Current: 6 mA_{p-p} ±2% square wave

Z-Modulation

Input: DC-coupled, TTL compatible, "HIGH" level blanks the display
Input Impedance: 10 kΩ
Maximum Input Voltage: 50V
Response Time: 35 ns

Power

Line Voltages and Frequencies
AC: 100...127V and 220...240V, 46...440 Hz
DC: 250...350V
Power Consumption: 50W at nominal line voltage
Dimensions: 316 mm W x 154 mm H x 460 mm L (12.4 in W x 6.1 in H x 18 in L)
Weight: 11 kg (24 lb)

Environmental Capabilities

Ambient Temperatures
Rated Range of Use: +5°C to +40°C
Limits for Operation: -10°C to +55°C
Storage and Transport: -55°C to +75°C

Altitude
Operating: to 5000m (15 000 ft)
Non-Operating: to 15 000m (45 000 ft)
Humidity: 21 days cyclic damp heat 25°C...40°C R.H. 95%
Shock: 30g: half sinewave shock of 11 ms duration: 2 shocks per direction for a total of 12 shocks
Vibration: Vibrations in three directions with a maximum of 15 min per direction; 5...55 Hz and amplitude of 0.7 mmp-p and 4g max. acceleration. Unit mounted on vibration table without shock absorbing material.
Recovery Time: Operates within 30 minutes coming from -10°C soak, going into 60% relative humidity at +20°C room conditions
Electromagnetic Interference: Meets VDE 0871 and VDE 0875 (Grenzwertklasse B)
Safety: Safety class I according to IEC 348

Included With instrument: Front cover with storage space, operating and service manual, BNC-banana adapter, contrast filter, 4 x10:1 attenuator probes, collapsible viewing hood and cal terninal - BNC adapter.

PM 3264

Ordering Information

Model

January 1989 prices

PM 3264Q 100 MHz 4-Channel Oscilloscope with trigger view	$4600

Accessories (Also see page 53)

Passive Probes

PM 8922/501 1:1 or 10:1 Probe, cable length 4 ft (1.2m)	50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8926 10:1 Passive Probe, cable length 5 ft (1.5m)	70
PM 8926/501 10:1 Probe, cable length 4 ft (1.2m)	$50
PM 8926/20 10:1 Passive Probe, cable length 8 ft (2.5m)	70
PM 8931/00 20 mΩ, 100:1 Passive Probe	125

Active Probes

PM 8940/09Q High Voltage Isolation Amplifier	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe	1000

Other Accessories

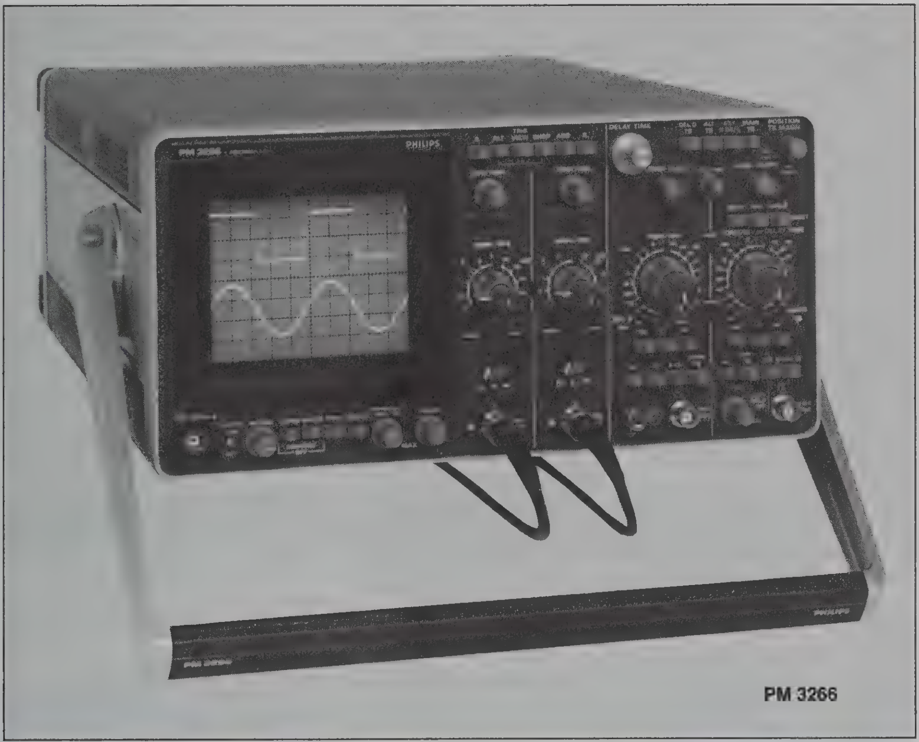
PM 8901Q Rechargeable Battery Pack	1275
PM 8910 Anti-Glare Filter	35
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8960/03 Rackmount Adapter	$250
PM 8976 Camera Adapter for stationary use	100
PM 8991/04 Oscilloscope Cart	450
PM 8992/66 Accessory Pouch	45
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9366 Collapsible Viewing Hood	20
PM 9381 Oscilloscope Camera	650

Service and Support

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3266


PM 3266

PM 3266 100 MHz Transfer Storage Oscilloscope

- 100 MHz/5 mV (2mV at 35 MHz)
- 1000 div/µs writing speed over full screen
- Adjustable background lighting level
- Auto erase with variable viewing times
- Storage times up to 1h
- Alternate time base display
- Trigger view usable as a third channel

The PM 3266 will capture repetitive or single high-speed events and store them for viewing, for up to 1 hour. Storage time is continuously variable from 15 seconds minimum. The two different storage modes include a fast mode utilizing a writing speed of 1000 div/µs, and a write mode with a 0.25 div/µs writing speed. A max. write position is included in the write mode circuit to provide a 2.5 div/µs writing speed.

A variable control allows optimum setting of the contrast between the oscillogram and screen background when operating in the fast mode.

In fast mode for repetitive signals, an auto erase facility refreshes the signal being observed allowing variable viewing times between 3 and 8 seconds.

Typical applications include observation, using the single shot mode of, e.g., various phenomena in discharge tubes, relays, etc. Also in digital systems the PM 3266 will capture glitches which occur randomly as interference signals.

Measurement accuracy has been increased to a high order by the extremely sensitive storage system combined with full screen display. Moreover operation of the various facilities has been made very easy. Controls are reduced to one variable control pluus a single push-button for each function (i.e. four push- buttons only).

Other facilities include alternate time base display plus composite triggering capability to allow the display of non time-related signals; the wide band trigger circuit operates well beyond the 100 MHz vertical bandwidth.

The trigger view system can also be used as a third display channel and vertical sensitivity ranges from 2 mV (up to 35 MHz) through 5 mV to 5V (at 100 MHz).

Specifications

Technical Specifications

CRT

Type: Philips high speed image transfer storage tube with scan magnification in vertical direction. Rectangular tube face, post accelerator and metal-backed phosphor
Screen: P31 (GH) phosphor
Acc. Voltage: 10 kV
Useful Screen Area: 8 x 10 div, each div equals 0.9 cm
Graticule: Internal with subdivisions along central axes. 10% and 90% lines are indicated

Writing Speed

Fast: 1000 div/µs
Max. Write: 2.5 div/µs
Write: 0.25 div/µs (measured after erasure) Lower writing speeds at higher contrast level can be adjusted
Storage Time: Up to 1 hour, in store mode depending on intensity setting. At max. intensity:
Fast: 15s
Max. Write: 15s
Write: 60s
Auto Erase: In fast mode. View time continuously variable between 3 and 8s
Persistence: In Write mode, continuously variable between 0.3 and 60s
Erasure Time: 1.3s in Write mode; 1.6s in Fast mode

Vertical or Y-Axis

Response
DC: 0 Hz...100 MHz (35 MHz at 2 mV)
AC: 7 Hz...100 MHz
Rise Time: 3.5 ns
Deflection Coefficients: 2 mV...5V/div. in steps in 1-2-5 sequence. Uncalibrated continuous control between steps 1:>2.5
Accuracy: ± 3%
Display Modes:
Channel A only
Channel B only
Alternate
Chopped at approx. 1 MHz
Channels A and B added
Trigger view
Trigger view with channels A and B alternate
Trigger view with channels A and B chopped
Channels A and B can be inverted
CMMR: >100:1 up to 2 MHz; >20:1 at 50 MHz
Input Impedance: 1 MΩ ±2% in parallel with 15 pF approx. RC time, AC coupled: 22 ms
Maximum Input Voltage: 400V DC-AC$_{pk}$ derating above 500 kHz
Maximum Deflection: Undistorted deflection of 24 div up to 35 MHz. Shift range 16 div
Signal Delay: 15 ns visible delay

Trigger View

Display: External or internal trigger signal
External: 100 mV/div

PM 3266

External ÷ 10: 1V/div
Trigger Point: Screen center ± 0.3 div
Time Delay Between Vertical Input and External Input: 3 ns

Horizontal or X-Axis

Horizontal deflection can be obtained from either the main time base or the delayed time base or a combination of the two, or from the signal source selected for X-deflection. In this case X-Y diagrams can be displayed using Y_A, Y_B, the Ext connector or the Line as a signal source.

Horizontal Display Modes:
Main time base
Main time base intensified by delayed time base
Delayed time base
Main time base and delayed time base simultaneously displayed (alternate)
X-Y of X-Y/Y operation with X-deflection by Y_A, Y_B, Line or Ext source

Horizontal Amplifier

Response: DC≥2 MHz (-3 dB)
Deflection Coefficient: 50 mV/div using Ext connector and 500 mV/div in Ext 10 switch position. Uncalibrated continuous control 1:>3. When Y_A, or Y_B, are used, sensitivities are 2 mV...5V/div
Measuring Accuracy: ± 3% (Ext. X-input)
Phase Error: 3° at 100 kHz

Main Time Base

Modes:
Auto, RC time 100 ms
Triggered
Single shot
Time Coefficients: 1s...50 ns/div in 23 calibrated steps, in 1-2-5 sequence. Uncalibrated continuous control between steps, (with UNCAL warning lamp should main time base be set out of calibration). x 10 magnifier extends max. sweep rate to 5 ns/div
Accuracy: ± 2% (+20°C...+30°C); ± 3% (+5°C...+40°C); Additional error for magnifier ± 1%
Variable Hold-Off: Sweep hold-off time can be increased by a factor of 10

Delayed Time Base

Modes: Delayed time base starts, either immediately after the delay time or, upon arrival of the first trigger pulse after the delay time
Time Coefficients: 0.5s...50 ns/div in 22- calibrated steps, 1-2-5 sequence. Uncalibrated continuous control between steps (with UNCAL warning lamp should delayed time base be set out of calibration). x 10 magnifier extends max. sweep rate to 5 ns/div
Accuracy: ± 2% (+20°C...+30°C); ± 3% (+5°C...+40°C); Additional error for magnifier ± 1%
Calibrated Sweep Delay: Continuous calibrated control between 0 and 10 x main time base setting
Incremental Delay Time Accuracy: 0.2 % typical
Delay Time Jitter: Better than 1:30 000

Main Time Base Triggering

Trigger Source: Internal Y_A, Y_B, Composite, Line External, External ÷ 10
Slope: + or -

Level Range

Internal: 24 div
External: +1.2V to -1.2V
External ÷ 10: +12V to -12V

Trigger Sensitivity

	Int	Ext	Ext ÷ 10
30 MHz	0.5 div	50 mV	500 mV
100 MHz	1.5 div	150 mV	1.5V

Trigger Coupling

DC: DC...full bandwidth
HF: 30 kHz...full bandwidth
LF: Internal 0...30 kHz; External 7 Hz...30 kHz
Ext. Trigger Input Impedance: 1 MΩ ± 2% in parallel with 15 pF approx.
Maximum Allowable Input: 400V DC-AC$_{pk}$
Trigger Jitter: Better than 0.5 ns

Delayed Time Base Triggering

Trigger Source: Internal: Y_A or Y_B; External; Other characteristics are identical to Main Time Base Triggering

Calibration

Calibrated Voltage: 3V $_{p-p}$ ± 1% square wave
Calibrated Current: 6 mA$_{p-p}$ ± 2% square wave

Z-Modulation

Input: DC-coupled, TTL compatible, "HIGH" level blanks the display
Input Impedance: 10kΩ
Maximum Input Voltage: 50V
Response Time: 35 ns

Power

Line Voltages and Frequencies
AC: 100...127V and 200...240V, 46...440 HHz
DC: 250...350V
Power Consumption: 50W at nominal line voltage
Dimensions and Weight: 316 mm W x 154 mm H x 460 mm L (12.4 in W x 6.1 in H x 18 in L) 10.9 kg (23.9 lb)

Environmental Capabilities

Ambient Temperatures
Rated Range of Use: +5°C to +40°C
Limits For Operation: -10°C to +55°C
Storage and Transport: -55°C to +75°C
Altitude: Operating: to 5000m (15 000 ft); Non-operating: to 15 000m (45 000 ft)
Humidity: 21 days cyclic damp heat 25°C...40°C R.H. 95%
Shock: Operating: 30g, half sine, 11 ms duration, 2 shocks per axis per direction for a total of 12 shocks
Vibration: Vibrations in three directions with a maximum of 15 min per direction; 5...55 Hz and amplitude of 0.7 mm$_{p-p}$ and 4g max. acceleration. Unit mounted on vibration table without shock absorbing material
Recovery Time: Operates within 30 min coming from -10°C soak, going into 60% relative humidity at +20°C
Electromagnetic Interference: Meets VDE 0871 and VDE 0875 (Grenzwertklasse B)
Safety: Safety class 1 according to IEC 348
Included: Front cover with storage space; operating and service manual; BNC-banana adapter; contrast filter; 2 x 10:1 attenuator probe PM 8928/00; collapsible viewing hood; cal terminal-BNC adapter

Included with instrument: 2 passive 10:1 probes, Blue CRT contrast filter, Front cover with accessory storage compartment, Operating and Service Manual, Collapsible viewing hood, BNC-banana adapter; cal terminal-BNC adapter.

Ordering Information

Model

January 1989 prices

PM 3266Q 100 MHz Oscilloscope	$7700

Accessories (See page 53)

Passive Probes

PM 8922/501 1:1 Probe, cable length 4 ft (1.2m)	50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8926 10:1 Probe, cable length 5 ft (1.5m)	70
PM 8926/20 10:1 Probe, cable length 8 ft (2.5m)	70
PM 8926/501 10:1 Probe, cable length 4 ft (1.2m)	50
PM 8931/00 20 MΩ, 100:1 Probe	125

Active Probes

PM 8940/09Q High voltage Isolation Amplifier	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe	1000

Other Accessories

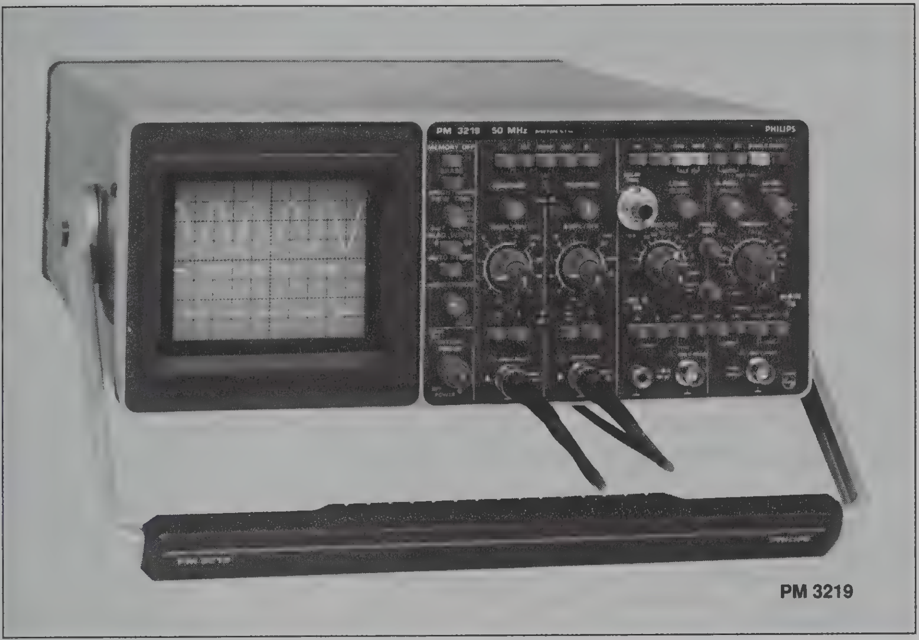
PM 8901Q Rechargeable Battery Pack	1275
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8960/03 Rackmount Adapter	250
PM 8976 Camera adapter for stationary use	100
PM 8991/04 Oscilloscope Cart	450
PM 8992/66 Accessory Pouch	45
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9366 Collapsible Viewing Hood	20
PM 9381 Oscilloscope Camera	650

Service & Support

One-year product warranty. See page 470 for further information on warranty terms and conditions.

The above configurations meet North American power requirements. For other power options, see page 491.

PM 3219



PM 3219

PM 3219 50 MHz Analog Storage Oscilloscope

- 2 mV sensitivity at 50 MHz
- Auto erase between 1 and 10s
- Auto store up to 24 hours in 'babysit' mode
- Dual slope triggering
- Ergonomic design
- Operation from most voltage/frequency line supplies and 21...30 Vdc

The PM 3219 has been designed to provide comprehensive, cost-effective storage of single-shot transients, low-frequency phenomena and other signals. It combines sophisticated facilities such as a 'babysit' mode and auto erase with an excellent 50 MHz specification. The unique storage facilities provide a wealth of capture and display possibilities.

Variable Persistence and Storage

The PM 3219 combines the dual advantages of variable persistence and variable storage. This allows, for example, low frequency signals to be displayed without flicker and also gives clear displays of fast pulses with low repetition rates.

Its use effectively adds a 'tail' to a slow-moving signal and thereby gives a continuous, flicker-free display. The persistence control allows the timing of this tail to be adjusted between 0.5s and 0.5 min. Storage time is also adjustable: signals can be retained and viewed for one minute at maximum brightness or for one hour at minimum brightness.

When the instrument's variable persistence and storage facilities are not employed, the PM 3219 can be used for a wide range of analog and digital measurement applications.

The 'Babysit' Mode

In this mode the instrument can capture either positive or negative going transient signals and store the results within a 24 hour monitoring period, without operator attendance. It is therefore possible to display and analyze transient events that have occcurred overnight, during the following morning.

Auto Erase Facility

Repetitive, low-frequency events are difficult to display. Setting the viewing time to coincide with the repetition time enables events to be captured and displayed one after another. Such a setting results in a virtually continuous signal of the events, but any change is seen immediately and if necessary that particular signal can be captured for a longer analysis simply by pushing the 'read' button before the next erase action occurs.

Specifications

Technical Specifications

CRT

Type: Philips rectangular mesh type post deflection accelerator tube with 8.5 kV accelerating voltage, half-tone storage
Screen: P31 phosphor, metal-backed
Useful Screen Area: 8 x 10 divisions of 0.9 cm
Graticule: Internal graticule

Persistence

Normal: Natural persistence of P31 phosphor
Variable: Continuously variable from ≤0.5s to ≥1 min

Storage Time

In 'Write' Mode: ≥1 min
In 'Read' Mode: ≥1h
In 'Auto Store' Mode: 24h

Writing Speed

Normal: ≥0.2 div/µS
Max. Write: ≥2 div/µS

Erase

Push-button Operated: Erasure time ~ 1.3s
Automatic: View time can be set between 1s and 10s. Scope automatically switches to single sweep operation
Auto Store: Scope is automatically switched to single sweep operation and stores a single shot

Vertical or Y-Axis

Frequency Response
DC: 0 Hz...50 MHz (-3 dB)
AC: 2 Hz...50 MHz (-3 dB)
Rise Time: 7 ns
Deflection Coefficients: 2 mV/div. 1-2-5 sequence. Uncalibrated, continuous control between steps 1:>2.5
Accuracy: ± 3% (auto store ± 5%)
Display Modes: Channel A, channel B, alternate, chopped at approx. 500 kHz, added. Channel B can be inverted
Input Impedance: 1 MΩ//20 pF
Maximum Input Voltage: 400V (DC + AC pk)
Maximum Deflection: Undistorted deflection of 24 div; Shift range 16 div
Signal Delay: Viewing of leading edge possible
CMRR-Factor: 100:1 at 1 MHz (A-B mode with 8 div common mode signal)

Horizontal or X-Axis

Horizontal deflection can be obtained from the main time base, the delayed time base, a combination of both, or from an external source. In this case X-Y diagrams can be displayed using Y_A, Y_B, the EXT connector or the mains as signal source for horizontal deflection.
Display Modes: X-Y of X-Y/Y operation with X-deflection by Y_A, Y_B, External or Line

PM 3219

X-Input

Deflection Coefficients: 200 mV/div using EXT connector; 2V/div using EXT ÷ 10 connector; Vertical attenuator coefficients apply when Y_A, or Y_B is used for X-deflection
Measuring Accuracy: ± 10%
Frequency Response: DC...1 MHz (-3 dB)
Phase Error: 3° at 100 kHz

Main Time Base

Mode: Automatic, triggered or single shot
Time Coefficients: 0.5s/div...100 ns/div in 1-2- 5 sequence. Uncalibrated, continuous control between steps 1:>2.5; x 10 magnifier extends max. sweep rate to 10 ns/div
Accuracy: ± 3%
Additional error for magnifier ± 2%

Delayed Time Base

The delayed time base either starts immediately after the delay time, or is triggerable after delay time by the selected delayed time base trigger source
Time Coefficient: 1 ms/div...100 ns/div in 1-2- 5 sequence. Uncalibrated continuous control between steps 1:>2.5
Accuracy: ± 3%
Sweep Delay: Variable in steps with main time base. Continuously variable with 10-turn potentiometer between 0.1x and 9.9x the time coefficient of the main time base
Incremental Delay Time Accuracy: 0.5%
Delay Time Jitter: 1:≥20 000

Main Time Base Triggering

Trigger Source: Internal Y_A, Y_B, Composite, Line External; External ÷ 10
Slope: + or - (full bandwidth) dual; 0...10 MHz

Trigger Modes

Auto: 20 Hz...50 MHz
DC: 0 Hz...50 MHz
AC: 5 Hz...50 MHz

Trigger Sensitivity

Internal: 1 div at 50 MHz
External: 200 mV at 50 MHz
External ÷ 10: 2V at 50 MHz

Level Range

Internal: ≥16 div
External: ≥3.2V
External ÷ 10: ≥32V
Automatically adjusted between limits of signal amplitude in position Auto

Variable Hold-Off: Continuously variable trigger hold-off
External Trigger Input Impedance: 1 MΩ//20 pF

Delayed Time Base Triggering

Trigger Source
Internal: Y_A, Y_B, Composite: Int. 2 div at 50 MHz; Ext. 400 mV at 50 MHz
Trigger Sensivity: 2 div at 50 MHz; Other trigger specifications of the delayed time base are identical to that of the main time base

Calibration

Voltage: $1.2V_{pp}$ ± 1% square wave
Frequency: 2 kHz

Power Requirements

Line Voltages and Frequencies: 110, 220 and 240VAC ± 10%, 50...400Hz ± 10%
DC Power Source: 21...30VDC, floating input, 1.5A max.
Power Consumption: 40W when powered from nominal line voltage
Z-Modulation: TTL compatible; "0" blanks the display
Dimensions: 335 mm W x 137 mm H x 470 mm L (13.2 in W x 5.4 in H x 18.5 in L)
Weight: 10 kg (22 lb)

Environmental Capabilities

Ambient Temperatures
Rated Range of Use: +5°C...+40°C
Limits for Operation: -10°C...+55°C
Storage and Transport: -40°C...+70°C
Altitude: Operating to 5000m (15 000 ft);
Non-operating: to 15 000m (45 000 ft)
Humidity: 21 days cyclic damp heat 25°C...40°C, RH 95%
Shock: 30g: half sinewave shock of 11 ms duration; 3 shocks per direction for a total of 18 shocks
Vibration: Vibrations in three directions with a maximum of 20 min per direction; 10 min with a frequency of 5...25 Hz and amplitude of 1.016 mm_{pp}; 10 min with a frequency of 25... 55 Hz and an amplitude of 0.5 mm_{pp}.
Maximum acceleration 3g. Unit mounted on vibration table without shock-absorbing material
Recovery Time: Operates within 30 min, coming from -10°C soak, going into room conditions of 60% RH at 20°C

Included with instrument: Front cover; 2 x BNC — 4 mm banana adapter; 2 x 10:1 passive probes PM 8926/001, 4 mm banana adapter, Operating manual

Ordering Information

Model

January 1989 prices

PM 3219U 50 MHz variable persistence Analog Storage Oscilloscope	$5250

Accessories (See page 53)

Passive Probes	
PM 8922/501 1:1 or 10:1 Probe, cable length 4 ft (1.2 m)	50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8926 10:1 Passive Probe, cable length 5 ft (1.5m)	70
PM 8926/20 10:1 Passive Probe, cable length 8 ft (2.5m)	70
PM 8926/501 10:1 Probe, cable length 4 ft (1.2m)	50
PM 8931/00 20 MΩ, 100:1 Passive Probe	125
Active Probes	
PM 8940/09Q High voltage Isolation Amplifier	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe	1000
Other Accessories	
PM 8901Q Rechargeable BatteryPack	1275
PM 8905 12 Vdc Power Converter	250
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8965/03 Rackmount Adapter	175
PM 8972 Camera adapter for stationary use	85
PM 8991/04 Oscilloscope Cart	450
PM 8992/15 Accessory Pouch	45
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9366 Collapsible Viewing Hood	20
PM 9381 Oscilloscope Camera	650

Service & Support

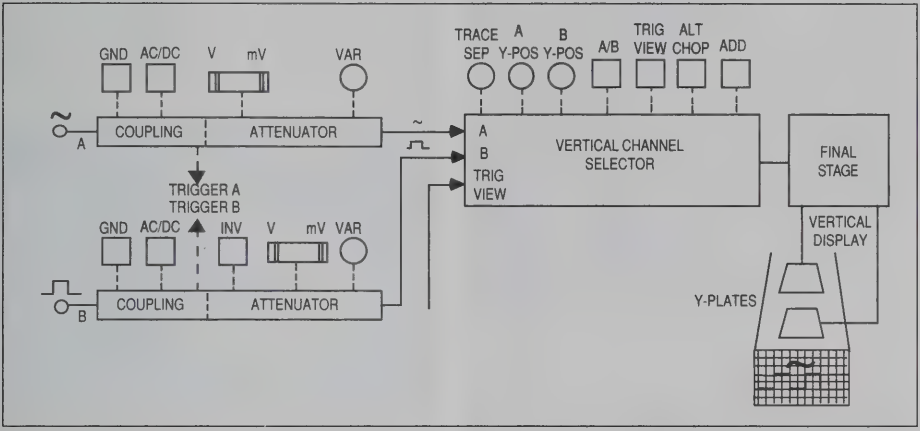
One-year product warranty. See page 470 for more information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

Digital Storage Oscilloscopes

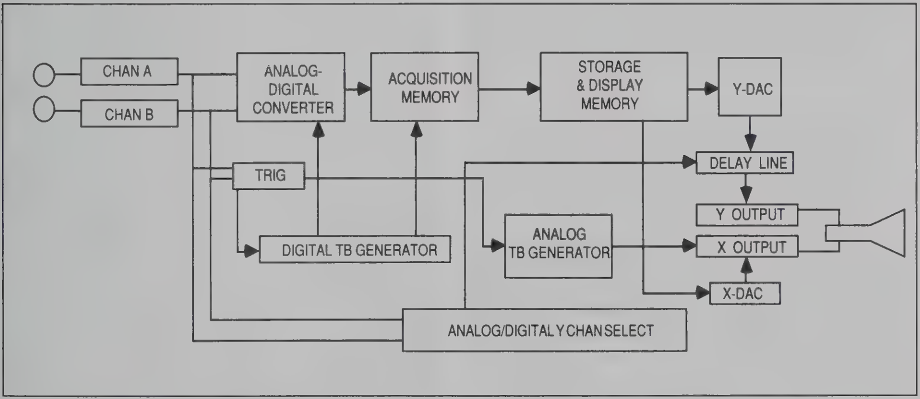
Digitizing - A block diagram

The functional block diagram of a digitizing oscilloscope shows many differences with the analog instrument. The block diagram of an analog scope is basically very simple: Input circuitry, attenuators, preamplifiers, channel switch, delay line, and output amplifier for vertical deflection, trigger selection trigger circuits, time-base(s) and horizontal output amplifier. (Plus, of course, the power supply and CRT.)



In a digital storage oscilloscope, or DSO, the input circuitry plays essentially the same signal conditioning role as in an analog scope, and is often constructed similarly. Because of the different triggering behavior of a DSO, a delay line is not required.

Digital Storage Oscilloscopes have a normal analog oscilloscope-type front end with attenuators and preamplifiers, followed by an Analog to Digital Convertor process. Digitized values representing amplitude data as sequential, momentary values of a signal are then stored in RAM. Memory contents are then displayed using a Digital to Analog Convertor, and displayed on a scope-type CRT, or using a flat Electro Luminescent display.



What Are the Advantages of Using a Digital Storage Scope Over Using an Analog Storage Scope?

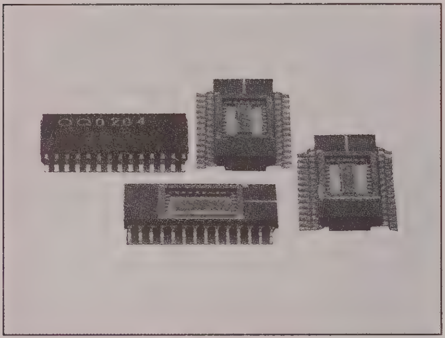
- With a Digital Storage Scope there is no risk of burning a storage layer inside the CRT since there is none.
- All displays of single events and repetitive signals are at the same brightness, regardless of sweep speed, and signal duty-cycle. Consequently, there is no need for continuous readjustment of focus, or astigmatism controls.
- Cursors can be moved freely over any waveform on the display, whether stored in memory as a single event, or as a repetitive signal.
- With a Digital Storage Scope, display parameters can be changed after a signal has been captured.
- Signals can be made available for data-processing, or the production of hard copies, using recorders, or plotters.
- Timing measurements are clock-based, and are more accurate.
- Amplitude measurements can be more accurate as well, because of the limited influence of linear circuitry.
- Storage times are virtually unlimited. With non-volatile memories, multiple waveforms can be stored for a period of many months after switching-off the instrument.
- Because of the long storage time capabilities, Digital Storage Oscilloscopes can wait for an unlimited time period for a signal to occur, without the screen "washing out". This translates to unlimited "babysitting".

What Performance criteria are important to the user?

- Sampling speed, determining the time resolution with which single events can be recorded and stored. Sampling speed is expressed in Megasamples/sec. (To avoid confusion with the instrument's bandwidth, it's best not to refer to MHz when talking about the sampling speed.)
- Bandwidth, and maximum stored frequency (MHz)
- Vertical resolution, expressed in bits, affecting an important aspect of achievable accuracy.
- Number of datapoints per record, per channel.
- Number of memories, available for signal comparisons and reference.
- Measuring capabilities.
- I/O capabilities.

Most Philips digital storage oscilloscopes employ a fast analog shift register (Charge Coupled Device or CCD) for fast and accurate signal capture. Once a signal is captured, the contents of the CCD are digitized and stored in memory. This mechanism ensures high effective vertical resolution at high clock speeds, even when capturing fast slew rate signals. Philips was the first to introduce the CCD technology to digitizing oscilloscopes. Based on the CCD conception in Philips' Physics labs in Waalre, the Netherlands (first published in 1966) and on Philips' extensive and world leading linear IC technology, a CCD, (also nicknamed "bucket-brigade"), and in particular the Profiled Peristaltic Charge Coupled Device (P^2CCD) proves to be a powerful, fast and efficient technique in the process of waveform digitizing. Rather than attempting to digitize high frequency waveforms or signals with fast transients with parallel digital conversion techniques, the P^2CCD provides a fast sampling, analog shift register to sample signal waveforms with excellent time resolution. The Philips chips used in Philips DSO's always incorporate two fast track-and-hold circuits, along with sample-and-holds and the CCD's themselves, as well as the output circuitry. They offer real time resolutions of up to 4 ns between data points, simultaneously on both channels, for the capture of single events.

Sampling is continuous and the samples are stored in analog format until the moment of triggering, at which point the input signal to the chip is slowed down and the samples are read out at the output of the chip in order to be digitized. An accurate sequential approximation A/D is used for this purpose. The overall result of such an arrangement is obtaining a high sampling speed while maintaining excellent vertical resolution, (even when digitizing fast slew rates), at low cost. For example, nowhere, at this moment, can you find a Digital Storage Oscilloscope that offers 100 Megasamples/sec on both channels simultaneously, at 8 bits, for a lower price than that of the Philips PM 3350!



Philips' proprietary P^{2}CCD's that allow high speed signal capture.

What Are the Criteria in Selecting a Digital Storage Oscilloscope?

Y-Resolution

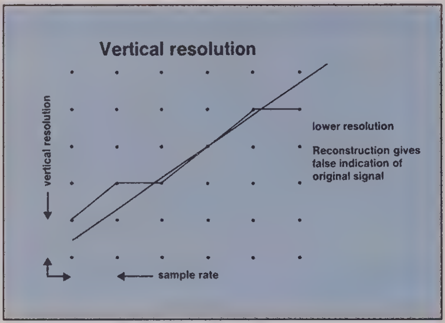
Since the description of a waveform and hence waveform fidelity is determined by the number of voltage levels available for storage, the specification of vertical bit-resolution is one of the key parameters and considerations in selecting and using a Digital Storage Oscilloscope.

Amplitude inaccuracy in a digitizing oscilloscope is the sum of the inaccuracies caused by linear circuits, plus the inaccuracy caused by the digitizing process.

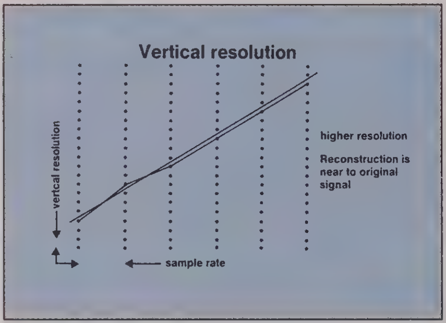
For example, for the Philips PM 3320A Digital Storage Oscilloscope, linear inaccuracy is specified as 1% of reading. With its 10 bit vertical resolution, the PM 3320A's A/D inaccuracy is 0.1% of full scale. Consequently, for a full scale signal, the overall amplitude inaccuracy will be 1 + 0.1 = 1.1%.

When details of signals are to be measured, which is often necessary, overall accuracy goes down. Examples are given to calculate the effects of full-scale digitizing, as well as digitizing accuracy of an amplitude of 10% of full scale for different types of conversions:

For a 10 bit conversion, as in the PM 3320A, accuracies are as follows:
At full scale: Lin error + A/D error = Result
1% + 100/1000 = 1.1%
For a 10 bit convertor, at 10% of full scale amplitude: 1% + (100/1000) x 10 = 2%
For an 8 bit conversion, as in most Philips DSO's and competitive models, accuracies are worse:
At full scale: Lin error + A/D error = Result
1% + 100/256 = 1.39%
For an 8 bit convertor, at 10% of full scale amplitude: 1% + (100/256) x 10 = 4.9%
For a 6 bit conversion, as in some models available from other manufacturers, things get quite dramatic and much worse:
At full scale: Lin error + A/D error = Result
1% + 100/64 = 2.6%
For a 6 bit convertor, at 10% of full scale amplitude : 1% + (100/64) x 10 = 17% !!!



Significant signal distortion can result from signal digitizing with insufficient vertical resolution.



Signal distortion is greatly reduced by increased vertical resolution.

Offset Considerations

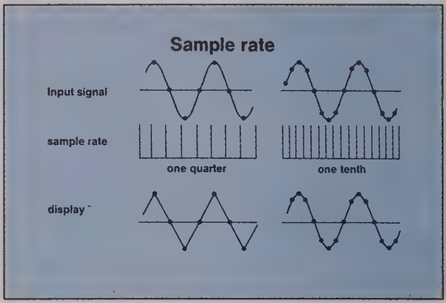
Inherent accuracy as offered by high-resolution Digital Storage Oscilloscopes such as the Philips PM 3320A, can be enhanced by input offset circuitry.

By using the built-in offset of up to 1000x the attenuator range used, no valuable vertical resolution is wasted on the conversion of DC. This way, all 10 bits of vertical resolution in the PM 3320A are utilized for digitizing the AC components of a signal with great accuracy. AUTO-OFFSET helps the user quickly find and use the appropriate offset voltage, which is then displayed in the CRT.

X-Resolution

The ability to resolve the signal's waveform in time, is determined by the speed of the A/D process. For single events, a good rule of thumb is that the A/D sampling speed be at least 10 x the highest frequency component of the signal to be captured, to obtain 10 datapoints per period. In other words, the highest frequency to be captured in a single shot mode is given by: Max sampling speed/10, for single shots.

It must be kept in mind that with a Digital Storage Oscilloscope, accuracies are related to the utilization rate with respect to Full-Scale settings. The accuracy with which timing elements of a signal can be determined, is directly related to the time resolution of the A/D process used, and the utilization of available datapoints by the operator. The higher the sampling rate, in other words, the higher the timebase speed used, the better the time resolution obtained.



Comparison of signal reproduction accuracy resulting from different sample rates. In the right-hand illustration, a sample rate of 1/10 of the signal frequency is used.

Different Sampling Techniques

Many Digital Storage Oscilloscopes have a vertical bandwidth which is far greater than can be utilized by the sampling speed of the A/D in a single shot mode alone. To allow full utilization of the scope's bandwidth, such scopes often offer a function which is called "Time-equivalent sampling". One system of "Time equivalent sampling" is called "Sequential Sampling". This function operates by taking one sample out of every successive period of a repetitive waveform, and reconstructing the wave shape out of these samples.

Another system operates on the "Random Sampling" principle, in which samples of the input signal are taken at random, with a precise time position measured and stored in memory, along with the waveform data for each point. The waveform is then reconstructed and displayed, with proper locations given to each point, depending on the time location measured at the moment of sampling. The benefit of the "Random Sampling" principle to the user is the ability to display pre-trigger signal information.

With either time-equivalent sampling method it is possible to store and display all frequencies that the front-end is capable of. Equally important, it allows the use of very high equivalent timebase sweep speeds, even with signals having very low repetition rates. Because waveforms are displayed from memory, the same uniformly high display clarity characteristic of any Digital Storage Oscilloscope are maintained.

Digitizing Ultra-High Frequencies

Many high frequency and high speed applications do require very wide bandwidths. Often, such application can benefit from all advantages that Digitizing Oscilloscopes have to offer: Automatic measurements of signal parameters, manipulation and calculation of wave forms, mass storage, and automatic go- no-go decisions.

One such instrument, the PM 3340, with a bandwidth of 2 GHz, is described in this catalog. Utilizing a sequential time-equivalent sampling technique, the PM 3340 offers a very high sensitivity of 1 mV/div at the rated 2 GHz bandwidth, and triggers to the full bandwidth as well. The PM 3340 offers full Digitizing Oscilloscope capabilities, including enveloping, save/stop on difference, histogram and FFT calculations, and EYE pattern and constellation diagrams for digital communication link testing.

Memories

Digital Storage Oscilloscopes can have multiple memories to allow reference waveforms to be stored. However, a primary selection criterion may be the length of each record that can be stored, especially in single shot applications. A long record with many datapoints allows the study of signal details after the single event has occured and been recorded.

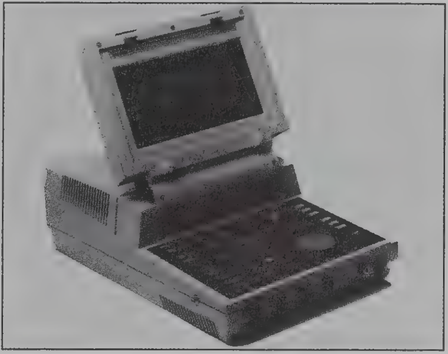
The PM 3308 and PM 3335 offer very long record lengths of up to 8k to facilitate this. In addition, the PM 3308 can store up to 100 waveforms in non-volatile memory, for waveform calculations and comparisons, and also eliminating the need for vulnerable mechanical mass-storage devices such as floppy or hard disk drives to be taken to the field.

There is usually a trade-off between the number of datapoints available in each record, and the speed and resolution of the A/D process. In some instruments, record lengths are a function of sweep speed used, and also dependent on the selection of resolution made by the user, when looking at repetitive waveforms. Digital delay techniques help to avoid filling memory locations with useless information and optimally combining A/D speed and resolution.

Displaying the Signals

In most Digital Storage Oscilloscopes, a CRT is used to display waveforms and operational settings.In order to provide sufficient measuring area along with clear and uncluttered operating information, the Philips PM 3320A and PM 3340 oscilloscopes offer extra large screens, leaving the measuring area unobstructed.

Unique in the field of powerful Digital Storage Oscilloscopes is the Philips PM 3308, offering a large flat screen. An electro luminescent display is used to provide excellent readability under all lighting circumstances. The display provides information on instrument setup, measurements and wave forms. As this active display is of the dot matrix type, focus controls are not needed and astigmatism is non-existent. It's small size enables it to be folded down like a clam-shell for protection and provides the PM 3308 with compactness and portability.



Cursor Measurements - Digital Storage Oscilloscopes

In a Digital Storage Oscilloscope, cursors are not merely electronic graticule lines displayed over the oscillogram on the screen, as is the case in an analog scope. Instead, in a Digital Storage Oscilloscope, cursors represent display highlights of actual datapoints present in memory. The numerical value of the delta-distance between cursors is therefore extremely accurate. Measurement accuracy of signal parameters is a function of the utilization of available memory width (vertical bits used) and timebase speed.

Since Digital Storage Oscilloscopes usually have an abundance of microprocessor power on board, many automatic calculations may be easily available, providing direct readouts of risetimes, mean values, RMS, frequencies, PP values etc. In the PM 3320A and PM 3340, for example, waveform calculations can be performed and parameters can be measured. Based on their 32 bit data structure and microprocessors, supported by Discrete Processing Units, these calculations and measurements can be executed and updated at high speed, even as the instrument is collecting new data. It is even possible to test newly collected waveform data against references and have the scope automatically take action when a newly acquired waveform violates predetermined waveform criteria.

I/O Considerations

Some analog oscilloscopes can be controlled by an external controller and sometimes interrogated so that knob settings can be stored, or values between cursors can be found. Good examples of such instruments are the Philips 60 MHz and 100 MHz PM 3050, PM 3065 and PM 3070 series, as well as the 200 MHz and 400 MHz PM 3285A/86A and PM 3295A/96A series.

DIGITAL STORAGE OSCILLOSCOPES allow for control and interrogation, but more importantly, they allow for transfer of waveform data from scope to controller and back. With this capability, all computing power of a controller becomes available for waveform processing, mass storage, comparison of waveforms and documentation.

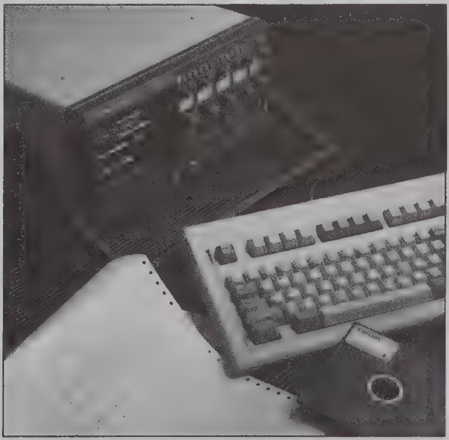
Software and Hardware Support for GPIB/IEEE-488* Applications

Digital Storage Oscilloscopes (DSO's) are often used in automatic test and measurement systems. Waveforms measured with a DSO are stored in its memory and can be processed/ displayed on request, or transferred to a computer for more extensive processing, display, mass storage or documentation.

All of the Philips Digital Storage Oscilloscopes are programmable, and addressable through the GPIB/IEEE-488 bus, and a number of them through the serial RS 232 port as well.

Fluke and Philips offer a number of software package to ease programming of GPIB systems applications. These PM 2230 Series Instrument Drivers and PM 2240 TestTeam allow GPIB instruments to be easily programmed and result in easy to understand and reliable test programs. The PM 2260 Oscilloscope Signal Processing software is a package for the PC and compatibles that extends the DSO's capabilities with an extensive set of interactive waveform processing and display facilities. For further information on these packages see page 58.

Extended "Probe-ability" is important in most applications in automatic test and measurement systems, where waveforms have to be sampled at several different points on the device under test. The PM 2295/09 Probe Switch Unit with a full 400 MHz bandwidth can be used for this purpose: under GPIB control it can switch 1 out of 4 signals to the input of the oscilloscope, still maintaining the high input impedance and low load at the tip of each of the four probes. For further information on this product see page 58.



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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3340

NEW

PM 3340

PM 3340 2 GHz Digitizing Oscilloscope

- DC to 2 GHz bandwidth
- 175 ps risetime
- Trigger response up to 2 GHz
- 4 memories of 4 kbytes x 10-bit words
- 1 mV/div vertical sensitivity
- Automatic measurements of amplitude, time, frequency and phase
- Signal processing including basic algebraic functions, plus filter, FFT and histogram
- Eye pattern mode for PCM inspection
- Standard GPIB/IEEE-488 and RS 232C interfaces
- Probes operate over full bandwidth
- Autoset function gives instant front panel set-up for any input signal

Introduction

The digitizing oscilloscope PM 3340 provides measurement, storage and analysis of input signals from DC to 2 GHz. The applied sequential sampling system not only provides you with a large display bandwidth, but also offers an unmatched 2 GHz triggering. Signal analysis is facilitated by a fast timebase including post- and pre-trigger modes, and a vertical dynamic range which permits the max. allowable input signal to be observed at an amplitude scale of 1 mV/div.

Measurement cursors provide a variety of automatic measurements, so that input signal parameters can be verified quickly and reliably. Signal processing modes such as FFT, digital filtering and save on difference are included as standard. A special eye pattern mode allows the display of random pulse patterns, such as in PCM or QAM, as well as the display of constellation diagrams.

The instrument is fully GPIB/IEEE-488* and RS-232C compatible. This includes computer controlled operation, data transfer between instrument and controller plus hard copies on standard plotters and printers.

In addition to its many powerful features, the PM 3340 is very easy to operate thanks to the Autoset facility, quickly updating its menu-driven analyzing functions and a setting memory for more than 250 preprogrammed front panel settings.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Reliable Measurements of High Speed Signals

Advanced technologies like ECL or GaAs need oscilloscopes that can display risetimes and propagation delays in the sub-nanosecond domain. PM 3340's risetime of 175 ps and 2 GHz bandwidth make the PM 3340 ideal for these applications. Moreover the pulse response, thanks to its 50Ω input and a sampling system actually at the input, is more reliable than in any analog or digital oscilloscope with conventional input attenuators and amplifiers. Inputs are via high-speed N-connectors combining ruggedness and a superior VSWR.

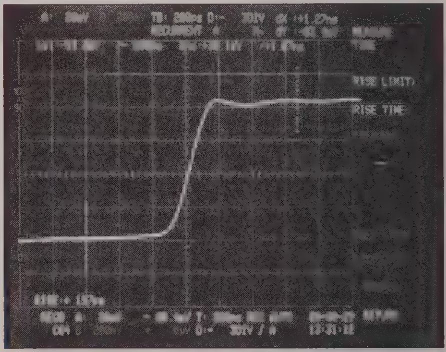


Fig. 1: Reliable pulse measurements are obtained from a carefully designed 50Ω input system.

Wide Dynamic Range

A floating input sampling bridge enables an input signal range of 1 mV/div up to 200 mV/div. This allows for any signal up to 1.6V to be expanded up to 1 mV/div with no distortion. Offset controls allow you to position any signal detail in the viewing window of 8 by 10 cm. Signal probes increase the range of 200 mV/div up to 2V/div or 20V/div if larger amplitudes have to be measured.

Noise Suppression

A high sensitivity input, together with the large bandwidth, can generate a noisy display. If so the averaging mode will reduce this noise drastically, enabling a clean display to be achieved even at the highest sensitivities.

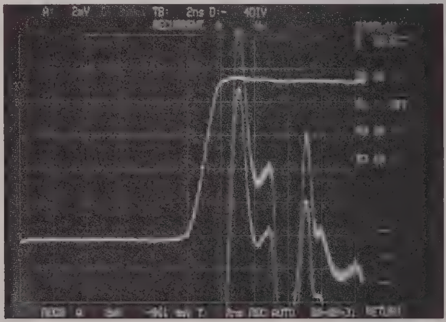


Fig. 2: A fast pulse is 100 x expanded and the resulting noise is subsequently suppressed by averaging the input signal..

Triggering up to Full Bandwidth

Many HF applications, for example in radar, satellite links or fiber optics, need GHz triggering. A new approach in the PM 3340 — a fast prescaler — extends trigger capabilities up to 2 GHz. Optimized trigger modes for low amplitudes (SYNC mode) and for high frequencies (COUNTDOWN mode) can be chosed by the operator, or selected automatically by the AUTOSELECT function. In both cases front panel LEDs show which mode is operating.

Waveform details both before and after the trigger point can be displayed. The selected negative (pre-trigger) or positive (post-trigger) delay is adjustable over a wide range dependent on the selected time scale. For example a signal in a 100 ps/div timebase can be shifted over 90 divisions pre-trigger and 70 divisions post-trigger.

Clear Unambiguous Display

The PM 3340 has a 10 x 12 cm CRT. The center area of 8 x 10 cm is used for waveforms; setting parameters and measuring results are displayed in the remaining screen part. Four signal memories enable comparison of waveforms or display of processing results. The contents of the non-volatile memory can be displayed simultaneously or individually and memory back-up ensures you always have a back-up of data.

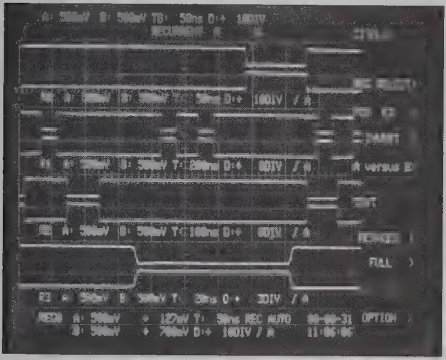


Fig. 3: Up to 8 waveforms can be displayed simultaneously (2 channels by 4 registers).

Waveform Measurements and Signal Processing

The PM 3340 offers a host of waveform measurements for both engineering and production environments. Once set, the instrument automatically measures time intervals, rise times, frequencies, amplitudes etc. without the need for resetting the scope for a new waveform. Time intervals between any waveforms in any register may be measured, allowing for example, automatic tests on semiconductor switching times.

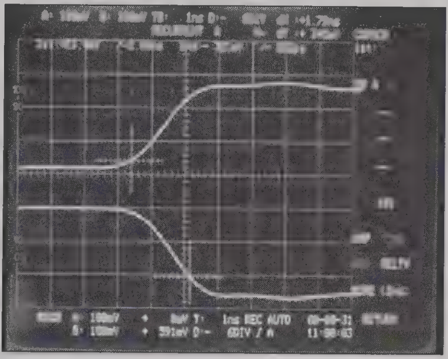


Fig. 4: Time interval measurements as required for semiconductor switching time.

Input signals can be checked for max. and min. deviations, for example for noise or jitter measurements, or signals passing a predetermined threshold can be saved automatically. An FFT function allows frequency rather than time do main display.

In many telecommunication systems using digital radio links or cable transmissions, datastreams are measured in the form of eye patterns. The PM 3340 offers a dedicated eye pattern mode in which signals are displayed with a unmatched sample density of 4000, or even 12000 in the multiple eye mode. This approach ensures that no information is lost, even in case of very noisy signals.

In case of Quadrature Amplitude Modulations (QAM) two signals, the In-phase (I) and Quadrature (Q), can be combined into a constellation diagram via the A versus B mode.

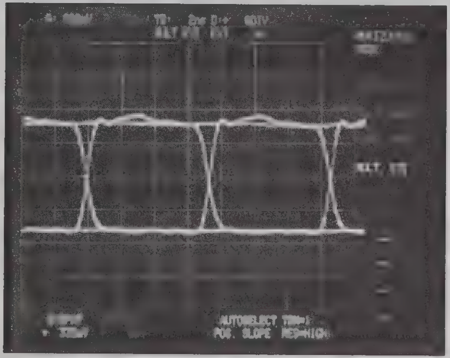


Fig. 5: Eye pattern formed by PCM signal.

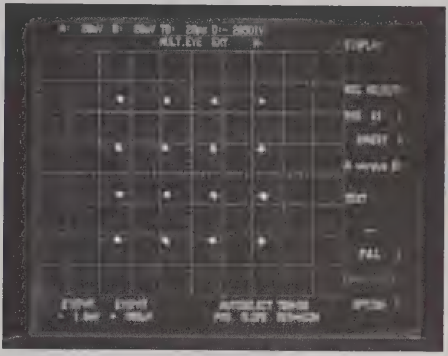


Fig. 6: 6 QAM signals presented on a constellation diagram.

Interfacing and Hardcopy

IEEE-488 and RS 232C interfaces are built-in as standard, allowing all controls to be set or interrogated and data transferred to and from any of the four memories. Digital printers/plotters can be used to obtain hard copies of waveforms with relevant alphanumeric data. An analog output for X-Y recorder is also available.

User Friendly Operation

Operation of the PM 3340 has been optimized for user-friendliness. All main functions are directly accessible and self-explanatory softkeyed menus provide the various signal processing functions. The CRT presents all waveform information on new input signals as well as the contents of any memory.

Initial set-up is by a single Autoset button, automatically providing an immediate on-screen display of both input signals. Repetitive measurement set-ups can be programmed and recalled via the setting memory keyboard, without the need for a computer. Two 32-bit microprocessors plus a Discrete Processing Unit assume quick updates of displays and measurements, further enhancing the operator interface.

Signal Probing

Many engineering applications ask for reliable signal pick-ups, with minimum loading of the signal source. Two 1 pF//500Ω passive probes with full 2 GHz bandwidth are included in the package. If higher DC impedance is required, 5 kΩ//1pF passive probes and a 1:1 FET probe (1 MΩ//1.5 pF) are also available.

Digitizing Scopes and High Speed Measurements

Any digitizing or digital storage oscilloscope uses the principle of sampling at regular time intervals. Sampled values are digitized and stored in a memory; then the original waveform is reconstructed by scanning the memory and displaying its content on a CRT.

PM 3340

Non-recurring input signals require the maximum possible number of samples to be taken while the signal is present: this is called real-time sampling. The sample rate determines the maximum signal speed of single events which can be captured by the oscilloscope.

Repetitive signals can be handled differently. Collecting the required samples can be spread over several periods of the input signal. This principle is called **repetitive sampling.** There are two ways in which repetitive sampling is performed:

- Random sampling, where the moment at which sampling occurs is determined by an internal clock and is not related to the input signal.
- Sequential sampling, in which the input (trigger) signal determines the moment at which sampling occurs.

The PM 3340 employs sequential sampling; samples are taken at increasing time intervals after the trigger moment. At least 512 signal periods are necessary to collect all samples for a complete reconstruction of the input signal.

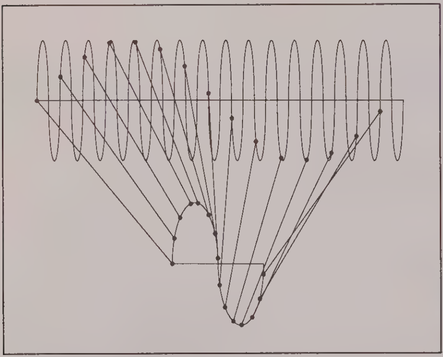


Fig. 7: Several periods of the input signal are sampled for reconstruction of the waveform.

Wide Dynamic Input Range

The input circuit has a high speed sampling gate which converts the input signals into an LF signal. The sampling gate is rebiased by a feedback circuit after each sampling action to the level of the last signal sample, so only differences between successive samples are measured, resulting in an excellent linearity over a wide dynamic range.

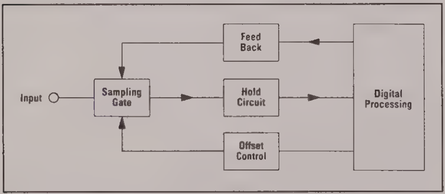


Fig. 8: Input circuit of sequential sampling scope.

The offset control allows the operator to scan the input signal to select any detail for precise observation.

High Bandwidth

The bandwidth of a sequential sampling system is determined by the sampling gate. A sample pulsewidth of less than 175 ps results in a bandwidth of at least 2 GHz. Trigger pick-off and delay line are part of the 50Ω impedance circuit, which contributes to the excellent pulse response of the instrument.

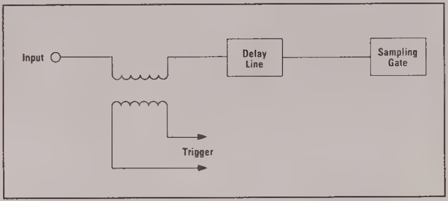


Fig. 9: VHF part of input.

Image Construction Speed

Different sampling systems give different speeds of display build up. Rather than random sampling, sequential mode only samples that part of the signal which will be displayed on screen. Moreover, as sequential sampling is related to the input signal, sample density is equal for all signal parts and no parts are missing.

Although for relatively low frequencies sequential sampling requires more time, at higher speeds this approach builds up the display much faster than other sampling systems, especially if parts of a waveform, such as risetime are measured

Specifications

Technical Specifications

Signal Acquisition

Autoset: Sets display, text, vertical settings, horizontal settings and triggering for instant overall-view display of input signal
Sampling: Sequential
Sources: Ya, Yb
Modes: Single-channel, dual-channel, added
Polarity: Each channel can be inverted
Processing: Normal, eye pattern (single- or dual-channel modes only), average, multiple sampling, absolute min/max

Range:
Vertical: 10 div
Horizontal: 10.2 x time/div

Resolution:
Vertical: 1:1024 (10-bit)
Horizontal: 1:512, 1:256, 1:128, 1:64 (in fast display mode 1:64)
Minimum Acquisition Time: <25 ms for max. horizontal resolution

Y Channels

Input Impedance: 50Ω ±1%
VSWR: 1:1.3 up to 1 GHz; 1:1.4 up to 2 GHz
Input Coupling: DC
Max. Input Voltage: 5 V_{peak}, pos and neg
Deflection Coefficient: 1 mV/div...200 mV/div. (in 1, 2, 5 sequence)
Error Limit: 1.5%
Deflection Coefficient in Eye Pattern Mode: 5 mV/div...200 mV/div
Error Limit: 10%

Continuous Control Between Steps:
Range: 3:1
Resolution: 1:4096 (12-bit)
Error Limit: 3%
Frequency Response: DC...2 GHz (-3 dB)
Risetime: 175 ps (calculated value using t_r = 0.35/bandwidth
Visible Signal Delay: 9 ns
Dynamic Range: -0.8V...+0.8V

DC Offset:
Range: -1.6V...+1.6V
Resolution: 0.01 div
Common Mode Rejection: 40:1 up to 100 MHz
Channel Isolation: 1000:1
Noise: <0.5 mV (RMS)
Averaging: x2...x64 in powers of 2
Multiple Sampling: x2...x32 in powers of 2

Timebase

Acquisition Mode: Recurrent, single scan, multiple scan, multiple eye, save/stop on difference

Deflection Coefficient:
Timebase: 1 ns/div...20 µs/div (error limit 3%)
Magnifier: x2 ... x50 (error limit - add 2%)
Fastest Sweep: 20 ps/div
Delay: Controllable in steps of div or screens
Maximum Negative Delay: 9 ns
Maximum Positive Delay: 10 div at timebase setting of 20 µs/div and magnifier x1
Hold-off Time: 30 µs...75 µs at max. horizontal resolution

Triggering

Sources: Ya, Yb, EXTernal
Input Impedance: 50Ω ±1%
Coupling: AC (RC time: 1 µs)
Max. Input Voltage: ±5 V_{peak}, pos and neg
Modes: Trigger, synchronize, countdown and AUTO select

Sensitivity:
Trigger Mode: 10 mV (up to 100 MHz)
Sync. Mode: 2 mV (up to 100 MHz)
Countdown Mode: 50 mV (up to 2 GHz)

Level Range:
High Sensitivity: +4 mV...-4 mV
Low Sensitivity: +40 mV...-40 mV
Level Resolution: 1:16384 (14-bit)
Slope Selection: + and -
Jitter: 7 ps (RMS, timebase at 1 ns/div.)

Memory

Memory: 4 memories of 4 k x 10-bit words
Functions: Clear, save, write, lock

Display

Modes: Dot join, dots only, invert, A versus B
Registers: Register R0, R1, R2 and R3 can be displayed in any combination

Expansion:
Horizontal: 1...64 in powers of 2 (Y vs t), 1...8 in powers of 2 (A vs. B), continuous control between steps
Vertical: x0.2, x1, x5
Position: All registers can be positioned independently
Horizontal: +5 div...-5 div (expansion x1)
Vertical: +5 div...-5 div (expansion x1)

Cursors

Vertical Resolution: 1:1024 (10-bit)
Vertical Error Limit: 1.5%
Horizontal Resolution: 1:4096 (12-bit)
Horizontal Error Limit: 3%

Setting Memory

Memory Size: 251 front panel settings
Functions: SAVE, INSERT, DELETE for storage or erasure of settings: RECALL, NEXT, PREVIOUS for recall of settings

Calibration Output

Squarewave Voltage:
Amplitude: 1V ±1% into 50Ω
Frequency: 100 kHz ±0.1%
Impedance: 50Ω ±1%
Risetime: 1.5 ns

Plot Output

Analog Outputs: Screen dump or register dump
Output Voltage Vertical: 1V
Output Voltage Horizontal: 1V
Error Limit: 3%
Pen Lift: TTL-compatible
Plot Time: Adjustable between 20 ms and 2s per dot
Digital Plot Output: HPGL and Philips language compatible: up to 4 screens on standard A4 size
Printer Plot Output: Compatible with Epson (FX80) and HP Thinkjet

CRT

Type: Philips 18cm rectangular PDA tube
Useful Screen Area: 10 cm x 12 cm
Graticule: Internal, with variable illumination
Acceleration Voltage: 16 kV

Power Supply:
Voltage: 90V...264 VAC
Frequency: 45 Hz...440 Hz
Power Consumption: 136W
Memory Back-Up: 2 LR6 batteries (Size AA)
Retention Time: 2 years

Interface

Interface board: contains IEEE-488 interface, RS 232C interface and real-time clock
IEEE-488 (IEC-625) Interface
Bus Driver: E2 (three-state)

Interface Functions:

Source Handshake	SH1	Fully capable
Acceptor Handshake	AH1	Fully capable
Talker	T5	Basic talker, serial poll, talk only and unaddress if MLA
Listener	L3	Basic listener, listen only and unaddress if MTA
Service Request	SR1	Fully capable
Remote/Local	RL1	Local lock-out
Parallel Poll	PPO	No parallel poll
Device Clear	DC1	Fully capable
Device Trigger	DT1	Fully capable
Controller	CO	No controller
Address	0...30	
Default Address	8	

RS 232C Interface:
Connector: RFI/EMI

Bus Drivers:
Data Circuits:
Spacing "0" >+3V (TxD)
Marking "1" <-3V (RxD lines)
Control Circuits:
ON >+3V (RTS, CTS, DSR)
OFF <-3V (DTR lines)
Current Output: <10 mA
Input Impedance: 300Ω
Output Impedance: 3 kΩ...7 kΩ
Input Voltage: -7V...+7V
Output Voltage: -25V...+25V

Interface Functions:
Baud Rate: 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600 or 19200 (input and output separately selectable)
Stop Bits: 1 or 2
Parity: Odd, even or none
Length: 7 or 8
Transmission: Asynchronous, full duplex

Handshake:
Software XON/XOFF
Hardware DSR/DTR and CTS/DTR

Serial Poll	ESC 7
GoTo Remote	ESC 2
GoTo Local	ESC 1
Device Clear	ESC 4
Device Trigger	ESC 8
Local Lock Out	ESC 5

Measurement and Mathematical Functions

Voltage Measurements: RMS (including or excluding offset voltage); Mean (including or excluding offset voltage); Peak-to-peak; Peak-to zero; Negative peak-to-zero; Overshoot and Preshoot

Time Measurements: Risetime (Falltime) over 10%...90% or 20%...80% of waveform, or within variable boundaries; Pulse width; Duty cycle (expressed as a percentage of period); Frequency; Phase

Mathematics

Result of calculation displayed in selected register and scalable for optimum display
Basic Arithmetic Operations: Add, Subtract, Multiply, Divide, Differentiate, Integrate
Amplitude Histogram: Amplitude density vs. absolute amplitude of an input signal
FFT: Frequency domain presentation of input signal
Window: Rectangular, Hamming, Hanning
Vertical Scale: lin. or log
Dynamic Range: 49.8 dB
Horizontal Scale: lin.
Filter: Digital filter of order 3, 5, 9, 17, 33, 65, 129
Delay Channel: Allows compensation of delay between channels or signal probes

Vertical Processing Modes

Eye Pattern: Displays pseudo-random pulse pattern, showing eye height and width
Absolute Min/Max: Measures and stores max/min changes in amplitudes of an input signals in a selected register (envelope mode)

Horizontal Processing Modes

Multiple Eye: Displays eye pattern in 12k memory size for optimum signal representation
Save/Stop on Difference: Input signals outside the limits of a reference signal are saved in a selectable register or stop the acquisition.

General Specifications

Mechanical Data

Height: 176 mm (6.9 in.): 250 mm (9.8 in.) with feet and pouch, 5E in 19-in. rackmount version
Width: 419 mm (16.5 in.): 465 mm (18.3 in.) with handle
Depth: 570 mm (22.5 in.): 670 mm (26.4 in.) with handle
Weight: 18.7 kg (41.2 lb.) excl. accessories

Environmental Characteristics

Meets environmental requirements of MIL-T-28800C Type III, Class 5, Style D

Temperature:
Rated Range of Use: +15°C...+35°C
Limits of Operation: 0°C...+50°C
Storage: -40°C...+70°C

Altitude:
Operating: 4500 m (15000 ft)
Storage and Transport: 12000 m (40000 ft)
Maximum Humidity: 95% RH
Vibration: Frequency 5 Hz...55 Hz
Maximum Acceleration: 30 m/s^2
Shock: 6 shocks on each axis, half-sinewave, plus duration 11 ms, peak acceleration 300 m/s^2

PM 3340

Bench Handling: MIL-STD-810 method 516, procedure V
EMI: MIL-STD 461 Class B, VDE 0871 and VDE 0875
Safety: Meets the requirements of IEC 348 Class 1, VDE 0411 Class 1 UL 1244, CSA 556 B

Included with the Instrument: 2 passive 10:1 probes PM 8911/08 with scale read-out (input impedance 500Ω//1 pF, cable length 1.5m), blue contrast filter, 2 BNC-N adapters, probe-BNC adapter, operating manual, programming manual, quick operating guide, cable for analog plot output

Ordering Information

Models

January 1989 prices

PM 3340/403 1 GHz Digitizing Oscilloscope including FFT and IEEE-488/RS-232 Interfaces	$16,000
PM 3340/803 same with 19-inch Rackmount	16,275

Accessories (Also see page 53)

PM 8911/08 Passive 10:1 Probe	275
PM 8912/08 Passive 100:1 Probe	275
PM 8943Q FET Probe	850
PM 8964/40 19 inch Rackmount Kit	650
PM 8991/04 Oscilloscope Cart	$450
PM 8992/80 Accessory Pouch	45
PM 2122/01 50Ω Coaxial Switch	680
PM 2195/09 Probe Switch 400 MHz	650
PM 2230/001 Instrument Drivers Software Service	590
PM 2240/001 TestTeam Software	925
PM 2260/001 Oscilloscope Signal Processing Software	800

Service and Support

One-year product warranty. See page 470 for further information on warranty terms and conditions.

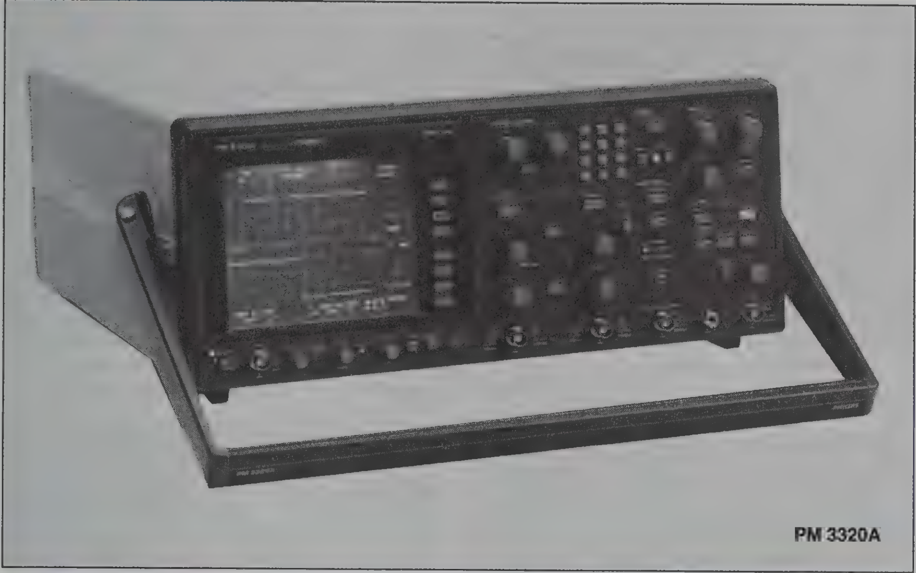
Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3320A

GPIB
IEEE-488

RS-232

NEW


PM 3320A

PM 3320A 250 Ms/s Digital Storage Oscilloscope
Bandwidth of 200 MHz
250 megasamples/sec sampling rate for each channel
4 ns horizontal resolution per channel, single shots
10 bit vertical resolution
Four 4K deep memories
Horizontal expansion of up to 128 times
Cursor measurements automatically include probe factors
Waveform processing capabilities

Extensive Acquisition and Display Functions

The PM 3320A has extensive acquisition, calculation and display functions to capture exactly the signals of interest and quickly extract the information and measurements required.

The PM 3320A offers an absolute min/max mode ('envelope' mode) that creates a cumulative record of signal amplitudes over the measuring period. Histograms that show the amplitude distribution of signals in the period can be displayed.

Also available are stop on difference and save on difference modes. These allow signals outside a predetermined range to be captured, after which acquisition stops ('stop on difference') or continues with successive overwriting of the acquisition information stored in the registers ('save on difference'). In both cases the signals are time and date stamped to help relate intermittent faults to possible external causes. In combination with the other acquisition modes such as pre- and post-triggering, offset and restart, the PM 3320A offers exceptional versatility in capturing and analyzing exactly the signal of interest. A complete measurement center in one unit.

Inputs and Signal Acquisition

The PM 3320A's power and versatility provide for a wide range of signal conditions. Two signal inputs are provided, each with a choice of 1 MΩ or 50Ω input impedance. The built-in 50Ω terminations are protected against damage through overloads by a combination of software and thermal protection.

Calibrated offset of up to 1000 x scalefactor permits the full utilization of the instrument's 10 bit vertical resolution.

Noisy signals can be acquired using a 'running-average' algorithm, taking into account up to 64 input signals. And signals with unknown DC components can be quickly displayed and stored using AUTO-OFFSET.

Further, the PM 3320A's fast 250 Ms/s digitizing rate applies to both channels, simultaneously, and synchronously. It offers a full 4 ns resolution for each channel, for repetitive signals and single events! And random sampling permits the use of higher time base speeds for repetitive signals, so that the full 200 MHz of the instrument can be used and stored.

Each channel is also provided with a dual, fast peak-detector which permits the capture of events down to 3 ns, even when slow time base speeds are used. This is not only useful to catch short glitch-type signals over longer time windows, it also allows the instrument to accurately digitize and display high frequency signals which are modulated in amplitude by a lower frequency, without aliasing.

For the slowest of signals, a roll mode is provided. The roll mode can be triggered, if desired, to stop at any significant signal detail.

Triggering and Delay Capabilities

The PM 3320A can be triggered from a choice of internal and external signal sources.

Pre-trigger of up to one full screen is possible, not only in the direct acquisition modes, but also at the higher time base speeds, thanks to the instrument's random sampling technique.

Extensive post-trigger recording with delays of up to 1000 screen lengths allows the analysis of small signal details out of long and complex signals. In addition, the RESTART function which operates as a 'Smart Autostart' make finding such details a snap and provide a better alternative to the traditional Delayed Sweep arrangement.

Trigger level can be checked in the CRT display for fast setup, for all selected trigger sources, whether internal, or external.

Trigger delay can also be used to give an internal time delay after an external event.

The PM 3320A also offers excellent TV trigger capabilities. (See also PM 8917.)

Storage

Signals from each channel can be stored in each of four 4K memories. This allows for easy comparison of waveforms, or the display of references. A unique, multiple-single-shot mode allows for quick and automatic storage of up to four dual-channel single shots.

All waveforms are kept with all relevant acquisition parameters, such as sensitivity, time base, and delay settings at the moment of recording. A real-time clock provides automatic 'time stamps'.

Full compatibility with GPIB/IEEE-488* and RS-232C allows for almost unlimited recording of waveform data on external devices.

Display and Soft Keys

The PM 3320A has a 10 x 12 cm CRT screen. The center 8 x 10 cm area is used for waveforms exclusively, with no disturbing alphanumerics.

The edges of the screen display waveform acquisition data, of live signals, or of previously recorded waveforms.

The right hand side of the screen is always used for soft-key displays. A separate numeric keypad allows direct input of pertinent data such as offset and delay.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3320A

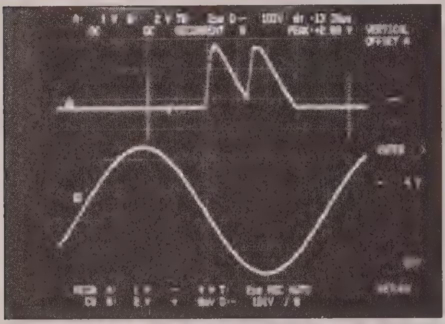
Operation and User Friendliness

All main functions of the PM 3320A are directly accessible to the user, without the need to learn soft-key menus. This also eliminates the time consuming need to back up through various levels of menus to change instrument settings.

And Philips' 'Green-button' Autoset provides for even faster set-ups by automatically defining acquisition parameters. This is a great help in finding and viewing previously unknown signals.

Once captured, waveforms are already displayed, with no interference from text or menus. All texts are displayed along the screen edges, with only channel identification (A or B) displayed with the relevant trace, for each memory.

The PM 3320A even shows a warning when aliasing due to undersampling is detected!

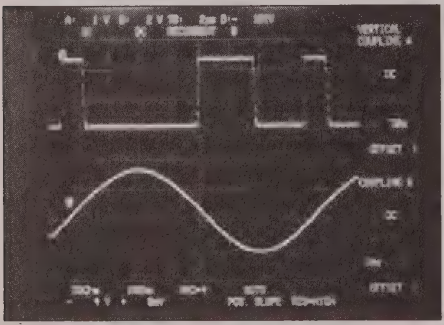


The PM 3320 screen is a complete information center. Because of the 10 x 12 cm screen size and a full 8 x 10 cm measuring area, no text is interfering with the displayed waveforms.

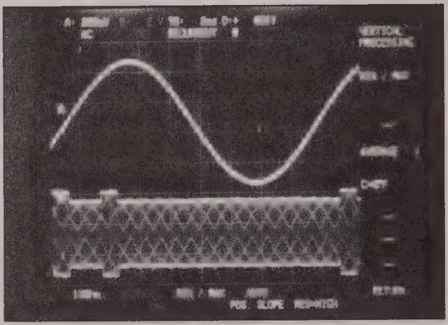
SetUp Memories

The PM 3320A's user-programmable setup feature allows even greater ease of use, providing automation without a computer. This also ensures repeatability of tests and results.

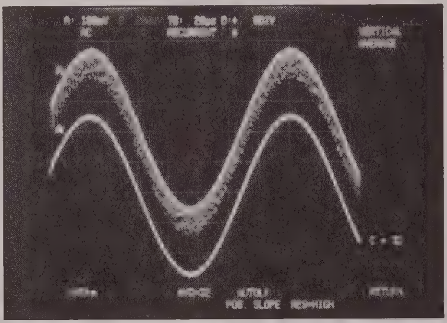
Up to fully 250 user-defined instrument setups can be stored for measurements of user-specific interest. These can be stored in combinations of sequences of steps, and can be recalled sequentially, or at random.



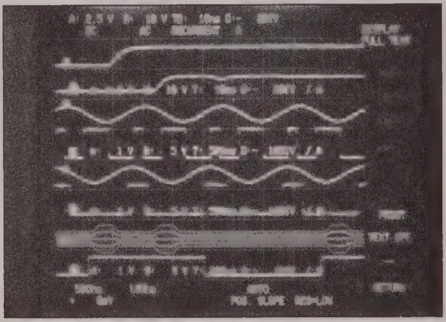
The PM 3320A has selectable 50 Ohm or 1 Megohm inputs. The 50 Ohm input termination is protected by software and thermal protection.



Vertical signal processing includes averaging, Bandwidth limit and Min./Max. incorporating a fast Track-and-Hold circuit in each channel to reveal spikes and glitches down to 3 ns, even at low time base speeds.



The PM 3320A's "running-average" not only reduces random noise, but it allows the user to maintain the instrument's full bandwidth and get the most out of the ultra-fine 10 bit resolution.



Signals from each channel can be stored in each of the four 4k deep memories. Memory contents are held in non-volatile memory, along with all relevant setting parameters, displayed here.

Versatile Measurement Functions

Once a signal has been acquired, the PM 3320A offers a full range of measurement and calculation functions to help you extract exactly the information you want from the signal. Measurements of voltage and time differences between the cursors positioned on a single waveform are possible. The PM 3320A also allows comparative measurements to be made between two waveforms recorded on channel A and channel B, or between separate waveforms stored in any of the instrument's four memory registers.

In addition to these absolute and relative time and voltage measurements, PM 3320A has the facility for phase measurements. In each case, all that's necessary is to position the cursors on the desired part of the signal or signals concerned, make a simple menu selection of the required measurement, and the result is indicated clearly and immediately by an on-screen alphanumeric read-out.

Cursors can also be used as 'Smart-Start cursors'. When the cursors are placed over any signal detail of interest, the activation of 'Restart', automatically reestablishes proper delay and sampling speed to acquire that detail with maximum resolution.

Advanced Signal Processing Modes

The PM 3320A offers more than signal measurements alone. A wide range of signal-processing modes allow you to explore more deeply into your acquired signals, and perform calculations that reveal hidden data and relationships.

The basic arithmetic functions of add, subtract, multiply and divide are supplemented by signal differentiation and integration, as well as amplitude histograms, the application of digital filters and an optional FFT facility for signal representation and analysis in the frequency domain.

Interfacing

The I/O option of the PM 3320A offers GPIB/ IEEE-488* and RS 232C interfacing. All controls can be set; all controls can be interrogated. Waveform data can be taken from any of the four memories, or be fed to the scope.

All front panel menus can be defined by the controller, as well as called by the controller, to greatly simplify bus operations.

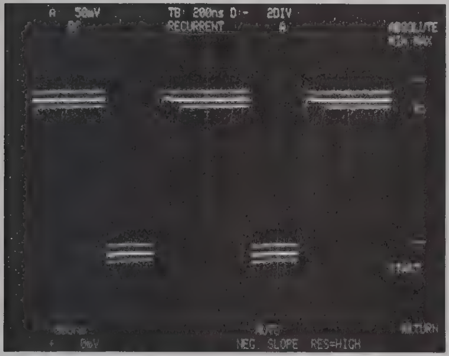
Hard Copies

Each PM 3320A is equipped with an analog output to drive an analog XY recorder. The operator can select any waveform in any memory to be drawn by the recorder.

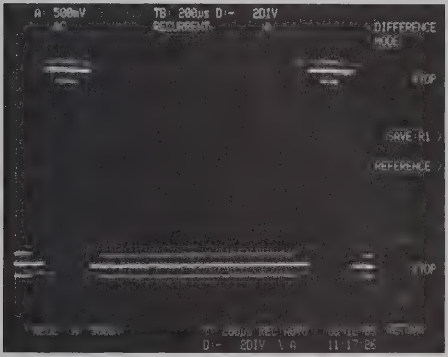
I/O option-equipped instruments further provide direct output to digital plotters. A digital plotout of any waveform is possible, along with alphanumeric data pertinent to that waveform.

Construction

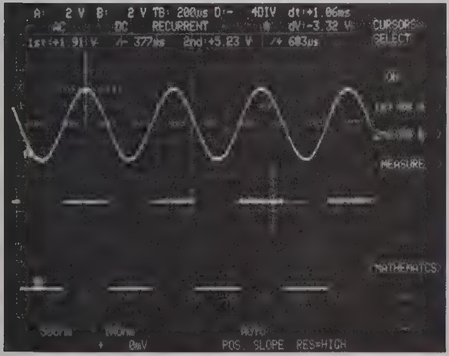
The PM 3320A's construction provides for a variety of operating configurations. At just under 18 kg, it can easily be carried from one location to another, and the carrying handle doubles as an adjustable stand. Scopecart PM 8991/04 offers further mobility. In addition, a rackmountable version of the PM 3320A for use in standard 19 inch racks is also available.



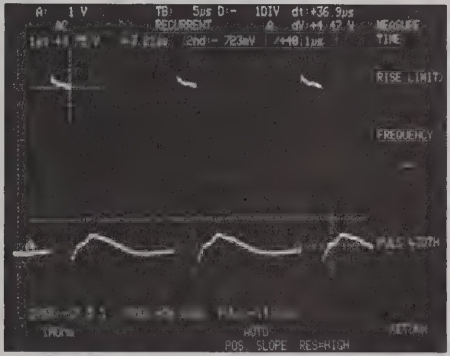
1. Absolute min/max mode creates the "envelope" of your signal variations for viewing drift and jitter.



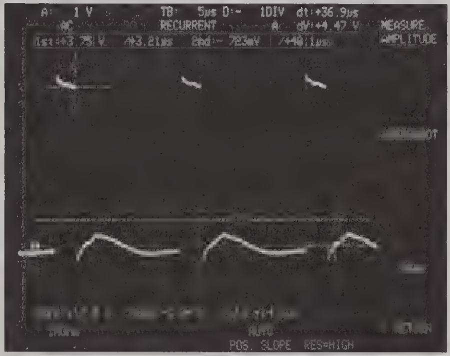
2. Use save/stop on difference together with the 3 ns glitch capture to detect and freeze intermittent faults (together with the time and date stamp).



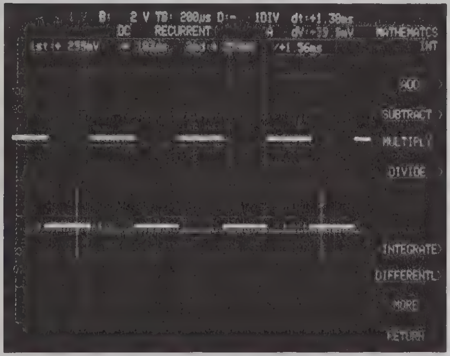
3. As should be expected of any high performance DSO, a wide range of measuring facilities are offered. Absolute ground referenced results are achieved on up to two traces selectable from any of the 8 displayable waveforms.



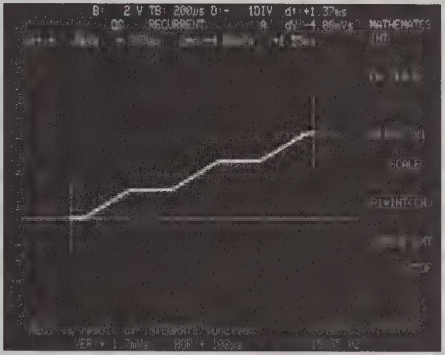
4. Together with the cursor measurements on a single trace, selection can be made from a wide variety of automatic and calculated results. Amplitude measurements of RMS, mean, peak-peak, pulse overshoot and preshoot can be readily selected.



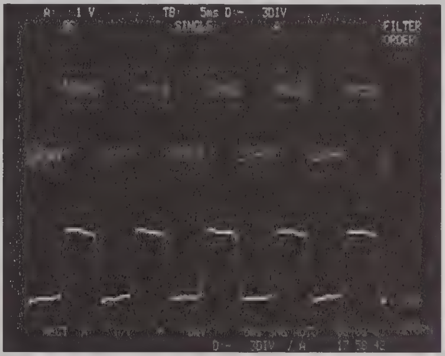
5. Further time measurements of frequency, period, pulse width, duty cycle and rise time are available to give timer/counter results. Even phase can be measured between channels and/or waveforms.



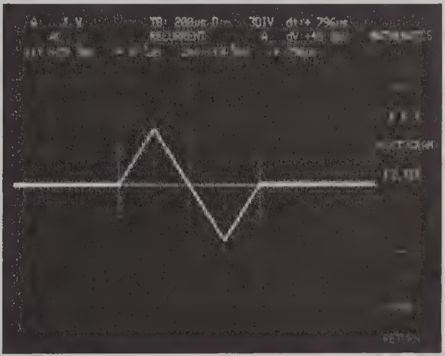
6. A full math facility gives processing power to display waveforms in the form you want.



7. A further example of the math facility — integrate — seen here as the integral of the signal between the cursors. A convenient display for use in "energy" measurements for example.

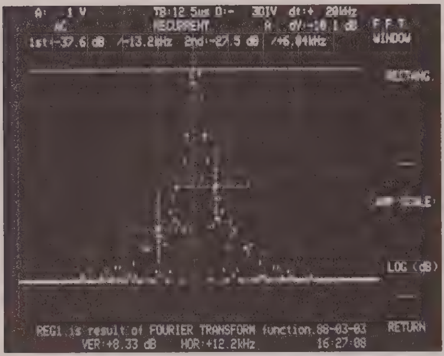


8. Further processing gives a new dimension to single shots buried in noise. These signals, unlike repetitive waveforms that can be "averaged" if noise exists, are once off. That means "average" cannot be used; however with post acquisition filtering, the true signal can be revealed.



9/10. To complement further the PM 3320A's extensive processing capabilities, an FFT (Fast Fourier Transform) option is offered. This allows selection of various windows (rectangular, hanning, hamming) together with a linear or logarithmic scaling of amplitude, to view quickly your signal in the frequency domain through calculation and display of the power spectrum. PM 3320A is one of the few general purpose instruments to offer such all round performance. (See photo 10. next page)

PM 3320A


A: 1 V
AC
TB:12.5us D:- 3DIV dt:+ 20kHz
RECURRENT
A dV:-20.1 dB
F F T
WINDOW
1st:-37.6 dB /-13.2kHz 2nd:-27.5 dB /+6.04kHz
RECTANG.
AMP SCALE
LOG (dB)
RETURN

REG1 is result of FOURIER TRANSFORM function.88-03-03
VER:+8.33 dB HOR:+12.2kHz 16:27:08

10.

Specifications

Technical Specifications

CRT

Philips 180 mm rectangular tube with 16 kV acceleration potential and P31 phosphor (GH). 100 mm x 120 mm useful screen area. 80 mm x 100 mm for traces.
Readout: Three separate areas reserved for front panel setting information, register parameters on softkey menus
Graticule: Internal with % indications. Illumination continuously variable

Autoset

Sets display, text, vertical mode, horizontal mode and trigger coupling in a predefined position. Other parameters depending on signal so that available signals are correctly recorded and displayed.

Signal Acquisition

Sampling Type:
Real time 200 ns/div...360s/div.
Equivalent time 5 ns/div...100 ns/div.
Maximum Sample Rate:
Real time sampling 250 Megasamples/s.
Equivalent time 10 Gigasamples/s.
External clock 50 kilosamples/s.
Vertical Resolution:
10 bits or 0.1% of full scale
Voltage resolution: 50 microvolt
Maximum Horizontal Resolution:
Single channel (single shot)
200 ns/div...500 us/div: 512 samples/acquisition; 1 ms/div...360s/div: 4096 samples/acquisition
Single channel (repetitive or single scan)
5 ns/div...100 ns/div: 512 samples/acquisition; 200 ns/div...360s/div: 4096 samples/acquisition
Dual channel (single shot)
200 ns/div...500 us/div: 512 samples/acquisition; 1 ms/div...360s/div: 2048 samples/acquisition
Dual channel (repetitive or single scan)
5 ns/div...100 ns/div: 512 samples/acquisition; 200 ns/div...360s/div: 2048 samples/acquisition
Acquisition Time: Real time 10.2 x time/division (exclusive delay time). Equivalent time 2s for 5 ns/div. (input signal dependent)
10 ms for 100 ns/div. (99% probability of all samples being updated).
Sources: Channel A and channel B (both channels can be inverted before acquisition).
Modes: Channel A or channelB; Channel A and channel B; Channel A and channel B added. Average mode and min./max. mode possible in all three modes.
Sample Difference Between A and B: Both channels are sampled simultaneously ±200 ps.
Acquisition Processing:
Absolute min./max. (envelope)
Averaging
Save on difference
Stop on difference

Channels A and B

Input Impedance (High Z): 1 MΩ in parallel with 14 pF
Input Impedance (50Ω): V.S.W.R. 1.2:1 at 200 MHz
Maximum Input Voltage (High Z): 300V (DC + AC peak) at 1 MHz
Maximum Input Voltage (50Ω): 5V DC and r.m.s.; 50V AC peak. Protected against selection with unsafe voltage on input connector.
Deflection Coefficients: 5 mV/div...5V/div. in 1-2-5 sequence. (Continuous control between steps)
Error Limit (Variable Calibrated): Overall 2%
Add 2% in min./max. mode
Dynamic Range: 10 divisions
DC Offset

	Range	Resolution
5 mV/div...20 mV/div.	±5V	5 mV
50 mV/div...200 mV/div.	±50V	50 mV
500 mV/div...5V/div.	±300V	500 mV

Shift Range: ±5 divisions
Frequency Response: DC...200 MHz (-3 dB)
AC coupled lower 3 dB point with 50Ω input 10 Hz; AC coupled lower 3 dB point with high Z input 1 Hz. Bandwidth limiter reduces bandwidth to 20 MHz.
Risetime (0.35/Bandwidth): 1.75 ns
CMRR: 120:1 at 1 MHz; 25:1 at 50 MHz
Min./Max. Function: Accuracy for pulse longer than 3 ns is 50%. Reset time 20 ns
Average: Continuous average where:

$$\text{New Value} = \text{Old Value} + \frac{\text{New Sample - Old Value}}{\text{Constant}}$$

And constant is: 32 x in roll mode. 2...64 x in other modes.

Time Base

Modes and Time Coefficients:
Recurrent: 5 ns/div...5s/div.
Single shot: 200 ns/div...5s/div.
Single scan: 5 ns/div...5s/div.
Multiple shot: 200 ns/div...5s/div.
Multiple scan: 5 ns/div...5s/div.
Roll: 50 ms/div...360s/div.
Absolute min./max.: 5 ns/div...5s/div.
Stop/save on difference: 5 ns/div...5s/div.
Error Limit: In equivalent time mode ±1%. In real time mode ±0.1%
Save/Stop on Difference: Time between end of last comparison and ready for next 100-150 ms dependent on memory resolution
Absolute Min./Max: Auto resets after 100 acquisitions or after 10s whichever occurs last (can be switched off)

Triggering

Sources: Channel A, Channel B, External, Line and External events
Impedance: 1 MΩ in parallel with 14 pF
Coupling: Signal triggering AC, DC, LF rej., HF rej., Auto level or TVF. Events triggering TTL, ECL or adjustable v
Maximum Input Voltage: 300V (AC + DC peak), at 1 MHz
Triggering Sensitivity

	Up to 300 MHz	Up to 200 MHz	Up to 30 MHz
Channel A and B	3 div.	1 div.	0.5 div.
External	0.3V	0.1V	0.05V
External/10	3V	1V	0.5V

Slope: Positive, negative or dual slope

Level Range:
Channel A and B: 8 div.;
External: ±0.8V;
External/10: ±8V,
Any source in AUTO: related to p-p value

Frequency Range:
Trigger coupling in DC: DC...300 MHz;
Trigger coupling in AC: 10 Hz...300 MHz;
Trigger coupling in LF rej.: 50 kHz...300 MHz;
Trigger coupling in HF rej.: DC...50 kHz

Trigger Delay: Range:
-10...9999 divisions (200 ns/div...360s/div.);
-10...500 divisions (5 ns/div...100 ns/div.);
1...9999 events (max. frequency 5 MHz),
Internal delay after event count

Memory

4 memories of 4K x 10 bit-words each

Display

Sources: Register R0, R1, R2 or R3 in any combination

Expansion
Horizontal: In steps 1x...64x (8x in A vs B). Continuously between 1x and 2x
Vertical: 0.2x, 1x and 5x

PM 3320A

Display Handling:
Smoothed;
Dots only;
Dot join;
All registers can be inverted
Position: ±5 div. horizontally and vertically from screen center for each register and/or individual trace.

Setting Memory

Memory Size: 250 front panel settings maximum
Functions: SAVE, INSERT or DELETE for storage or erasure of settings. RECALL, NEXT or PREVIOUS for recall of programmed settings.
Configuration: Front panel settings can be grouped as main and sub settings in order to reach a number of closed sequences each with an own number of steps.

Calculation Functions

All waveform calculations can be performed with results stored in different registers from source register. Original waveform needs never be affected.
Add
Subtract
Multiply
Divide
Differentiate
Integrate
Amplitude histogram
FFT (optional)
Digital filter
Filter: Breakpoint related to filter order and TB by (0.72/N+1)*f sample where N=filter order and f sample=sample rate (dependent on [TB*10]/memory depth).
FFT (option): Range of amplitude display 48.9 dB. Positive spectrum display resolution 2000 points single channel, 1000 points dual channel. Frequency resolution related by TB/10.24 DC point is mid-memory.
FFT Windowing: Rectangular, Hanning or Hamming with linear or logarithmic scaling
FFT Calculation Time: No windowing; linear display 6 secs; windowing and logarithmic display, 15 secs.

Cursors

Max. Horizontal Resolution: Single channel mode 1:4096; Dual channel mode 1:2048
Vertical Resolution: 1:1024
Read Out Resolution: 3 digits
Error Limit: ±2% of voltage; ±0.2% of time
Range: Visible part of signal

Measurement Capabilities

dV
RMS
Pk-Pk
Max
Min
dt
1/d
Delay
Rise/fall
Rise/fall-ECL
Overshoot
Preshoot
Mean
Absolute volts
Volts Ch-Ch
Volts Reg-Reg
Relative time
Relative volts
Rise/fall-VAR
Frequency
Period
Width
Duty
Phase
Time Ch-Ch
Time Reg-Regt

Calibration Output

Squarewave;
Internal impedance 50Ω;
Output voltage 1V;
Output current 20 mA;
Frequency 2 kHz

Interfaces (optional)

Interface board is available containing IEEE-488 or IEC-625 interface, RS 232C interface and a real time clock.

IEEE-488 (IEC-625): Busdriver. E2 (Three-state). "Interface Function Repertoire"

Source handshake	SH1	Complete capability
Acceptor handshake	AH1	Complete capability
Talker	T5	Basic talker, Serial poll, Talk only and Unaddress if MLA.
Listener	L3	Basic listener, Listen only and Unaddress if MTA.
Service request	SR1	Complete capability
Remote/local	RL2	No local lock out
Parallel poll	PP0	No parallel poll
Device clear	DC1	Complete capability
Device trigger	C0	No controller
Default address	8J	No controller

RS 232C
Connector: RFI/EMI
Busdrivers: Data circuits Spacing "0" > +3V; Marking "0" < -3V (T x D and R x D lines) Control circuits ON> +3V; OFF< -3V (RTS, CTS, DSR and DTR lines)
Current Output: <10 mA
Impedance: Output 300Ω; Input 3 kΩ...7 kΩ
Voltage: Output -7V...+7V; Input -25V...+25V

Interface Function Repertoire
Baud-rate: 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600 or 19200 (input and output separately selectable)
Stop-bits: 1 or 2
Parity: odd, even or no
Length: 7 or 8
Transmission: Asynchrone, full duplex
Handshake: Software ENQ/ACK or XON/SOF; Hardware DSR/DTR or CTS/DTR
Serial Poll: ESC 7
Go to Remote: ESC 2
Go to Local: ESC 1
Device Clear: ESC 4
Device Trigger: ESC 8
Digital Plot (option /403 and /803)
Language: Selectable HPGL or Philips protocol dependent on plotter type
Plotter select: Philips PM 8153/1, PM 8153/6, PM 8154, PM 8155 HP 7450, HP 7475A
Pen select: Pen 1 for Ch A
Pen 2 for Ch B
Pen 3 for Register Ch A
Pen 4 for Register Ch B
Pen 5 for graticule and alphanumerics
Plot area: Softkey selectable
Dot Matrix Printer
Screen Dump: Compatible with Epson FX 80 and HP Thinkjet®
Drawing Area: 10 cm x 10 cm

Analog Output

Screen dump or register dump possible. Output voltage 1V horizontal and vertical (±3%). Pen lift TTL compatible. Plot time adjustable between 20 ms...2 sec per dot.

General Specifications

Power Supply

Nominal AC Voltage Range: 100...240V
Nominal Frequency: 50 Hz...400 Hz
Power Consumption: With options 160W nominal
Memory Backup for Settings and Traces: Two LR6 batteries are required

Mechanical Data

Height: 176 mm (6.9 in); 250 mm (9.8 in) with feet and pouch; 4E in 19-inch rackmount version
Width: 419 mm (16.5 in); 465 mm (18.3 in) with handle
Depth: 570 mm (22.5 in); 670 mm (26.4 in) with handle
Weight: 18 kg (39.6 lb) excl. accessories

Environmental Characteristics

Meets environmental requirements of MIL-T-28800C Type III Class 5, Style D.
Temperature: Operating 0°C...+50°C; Storage -40°C...+70°C
Maximum Humidity: 95% relative humidity
Maximum Altitude: Operating 4.5 km (15 000 ft); Non-operating 12 km (40 000 ft)
Vibration: Frequency 5 Hz...55 Hz. Max. acceleration 30 m/s2
Shock: 6 shocks each axis, half sine wave, pulse duration 11 ms, peak acceleration 300 m/s2. Bench handling. (MIL-STD-810 method 516, procedure V).
EMI: MIL-STD-461 Class B. VDE 0871 and VDE 0875.
Safety: The instrument meets the requirements of IEC 345 class I, VDE 0411 class I, UL 1244 and CSA 556B.

Included With instrument: 2, 10:1 passive probes, Blue contrast filter, Operating Manual

Ordering Information

Model

January 1989 prices

PM 3320A 250 MS/s Digital Storage Oscilloscope	$8990

Optional Configurations

When ordering, select basic "PM" model desired from above, and substitute the configuration option number listed below as a suffix:

/003 Basic configuration	N/C
/013 Basic configuration, plus FFT	add 1000
/303 Basic configuration, plus 19 in. rackmount	add 280
/313 Basic configuration, plus 19 in rackmount and FFT	add 1280
/403 Basic configuration, plus IEEE-488/RS 232 interfaces and plotter drivers	add 1000
/413 Basic configuration, plus IEEE-488/RS 232 interfaces, plotter drivers, and FFT	add 2000
/803 Basic configuration, plus IEEE-488/RS 232 interfaces, plotter drivers, and rackmount	add 1180
/813 Basic configuration, plus IEEE-488/RS 232 interfaces, plotter drivers, rackmount and FFT	add 2280

Example, Ordering Configuration

To order the basic oscilloscope with rackmount and FFT, select:

	Model	**Price**
Oscilloscope	PM 3320A	8990
Configuration Option Suffix	/313	1280
Complete Model Number	PM 3320A/313	10270

Accessories (See page 53)

Passive Probes

PM 8911/09 500Ω, 10:1 Probe with readout, cable length 1 m (3 ft)	$125
PM 8912/09 5 kΩ, 100:1 Probe with readout, cable length 1 m (3 ft)	125
PM 8924/00 1:1 Probe, cable length 1.5 m (5 ft)	60
PM 8929/09 10:1 Probe with readout, cable length 1.5 m (5 ft)	90
PM 8929/19 10:1 Probe with readout, cable length 1 m (3 ft)	90
PM 8929/29 10:1 Probe with readout, cable length 2.5 m (8 ft)	90
PM 8931/09 20 MΩ, 100:1 Probe with readout	135
PM 9599/09 Set of VHF Attenuators	200

Active Probes

PM 8940/09Q High Voltage Isolation Amplifier with readout	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe with readout	1000

Other Accessories

PM 8917/003 Video Sync Separator and Line Selector	$550
PM 8956/001 Retrofittable IEEE-488 (GPIB) and RS 232 interface	985
PM 8977/00 Camera Adapter for stationary use	150
PM 8992/80 Accessory Pouch	45
PM 8991/04 Oscilloscope Cart	450
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9310/00 Collapsible Viewing Hood	12
PM 9311/00 Long Viewing Hood	85
PM 9381 Oscilloscope Camera	650
PM 2122/01 50Ω Coaxial Switch	680
PM 2195/09 Probe Switch 400 MHz	650
PM 2230/001 Series Instrument Drivers Software	590
PM 2240/001 TestTeam Software	925
PM 2260/001 Oscilloscope Signal Processing Software	800

Service and Support

Three-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3308

GPIB IEEE-488

RS-232

NEW

PM 3308

PM 3308 40 Ms/s Compact Digital Storage Oscilloscope

- Bandwidth of 100 MHz
- 40 Ms/s maximum sample rate
- 8 kbytes deep acquisition memory
- 180 kbytes non-volatile RAMdisk for up to 99 waveform storage
- 22 cursor measurement functions
- Powerful mathematic processing capabilities
- Large flat electroluminescent display

High Performance and Portability

The new PM 3308 is the ideal DSO to meet advanced field service requirements. With very compact design, this advanced instrument offers a convenience and portability never before achieved in a high-performance oscilloscope. The lightweight, low profile package weighing only 14.5 lb (6.5 kg), has a convenient shoulder strap making it easy to carry and bring real DSO measurement power exactly where it is needed.

And there is another equally important side to this versatile instrument's capability — it has a performance that's more than a match for any full-size instrument in its class. PM 3308 offers no-compromise test bench functionality that meets the most stringent demands for signal capture, measurement and analysis facilities.

Advanced Technology Electroluminescent Screen

The electroluminescent screen, the first fitted to an oscilloscope, delivers an unmatched combination of exceptionally compact overall instrument construction and outstanding display performance. The 512 X 256 pixel screen module has a high resolution of 3 dots per mm. The completely flat screen is free of parallax errors and other non-linear distortions, while the wide viewing angle of 140 degrees allows the display to be read clearly at almost any working angle. Focus is guaranteed correct with no need for adjustment. Text and trace color is amber, very clear and easy-on-the-eye, with exceptional contrast against the black display background.

Clear Control Layout

Contributing to its simple, secure operation, the PM 3308 has a clear control-panel layout with keys grouped by type of function; for example, those controlling the display, time, triggering and vertical settings. Keys performing on-screen functions are light brown for instant identification and those for other functions are dark brown. Cursors, trigger levels, delays and other settings are conveniently and quickly controlled by a rotary-action dial with the selected function indicated by LEDs.

Clear On-Screen Information

The PM 3308's clear and steady electroluminescent display is divided into three separate areas for at-a-glance read-out.

The trace section has a clear 6.4 X 8.8 division graticule. An information area displays instrument settings and the results of measurements being performed. A third area is displayed when a softkey function is called, with a "pop-up" menu displayed temporarily over the right hand side of the trace section. Once the final selection has been made, the menu pops-down again for a clear view of the waveform.

The total display measures 192 x 96 mm.

Instant-Action Autoset

Like most other Philips oscilloscopes, the PM 3308 has a multi-function Autoset control that automatically sets timebase, amplitude and triggering so that an incoming signal is optimally displayed. This valuable function provides instant signal viewing and measurement capability.

Powerful Acquisition Performance

The compact dimensions and easy portability of the PM 3308 in no way force any compromise on signal-acquisition performance. Two signal inputs are provided, together with a third external trigger input. Bandwidth is a full 100 MHz at a maximum sampling rate of 40 Ms/s on one channel. Maximum acquisition memory is 8 kbytes with an 8-bit vertical resolution, providing a powerful combination of speed and measurement length for detailed signal capture. Even fast glitches and single-shot phenomena can be reliably caught with a glitch-capture capability down to 10 ns.

The 5 MHz bandwidth limiter can be used in low frequency applications to cut-out noise and moreover, unwanted noise can be reduced further with an averaging capability for up to an astonishing constant of 10,000 signal averages.

PM 3308

For slow response signals, a roll mode is included down to 1 hour/div, giving over 200 hours of recording time.

Trigger and Delay Capabilities

The PM 3308 can be triggered from different internal and external sources. In real-time sampling mode, pretrigger of up to one full acquisition record is possible; if the full 8 kbytes is used it allows a maximum pretrigger value of over 200 divisions. The delay after trigger facility delays the signal for up to 999 divisions, so you can zero-in on exactly the part of the signal you want to study.

Furthermore, in real-time sampling mode, the DC-trigger accuracy is an exceptionally high 0.8%, for precise determination of the trigger moment. This gives an accuracy comparable to timer/counters for single shot time interval measurements.

For signals that are very noisy or suffer from interference or distortion, the PM 3308 has a unique variable hysteresis trigger capability. This feature allows for a stable triggering of those signals usually difficult to trigger by effectively 'desensitizing' the trigger moment; not just low pass filtering but by a calculated decision on the digitized waveform. The hysteresis can be set at up to 50% of range.

On-Board Storage Memory

Additional versatility is provided by a non-volatile 180 kbytes RAMdisk, which provides a valuable storage facility for user data and instrument settings without the vulnerability of a removable mass storage system. Up to 100 traces can be stored for later analysis and comparison, or for down loading to a PC. Alternatively, up to 100 complete instrument settings can be stored — particularly valuable for repetitive testing. Combinations of traces and settings can also be stored, with automatic memory partitioning.

Powerful Signal Processing

No less than four separate traces can be displayed simultaneously: the normal input channels A and B, plus additional, computed traces resulting from operations such as addition, multiplication, division, subtraction, integration or differentiation. These math functions are standard on the PM 3308 and can be performed either directly on input channels via channel A or channel B, or on stored signals. With this on-board computing power, the PM 3308 can instantly provide complex calculated results such as signal energy and power. If desired, signal smoothing can be selected to reduce the effects of noise.

Cursor Measurements

An extensive range of easy-to-use cursor measurements makes it easy and quick to get exactly the required signal information. Facilities of the PM 3308 include a comprehensive selection of both vertical and horizontal measurements. Vertical measurements comprise:

- Voltage differences between cursors,
- peak-to-peak and RMS values,
- average DC levels and mean trace voltages,
- cursor-to-zero and reference-to-zero voltages,
- 10 to 90% of voltage between cursors,
- 50% voltage for 1/2 peak-to-peak component over area defined by cursors,
- maximum and minimum voltages between cursors,
- linear and log ratios of V and V_{rms} measurements of two signals.

Horizontal measurements allow even further analysis of waveforms, particularly with respect to time:

- Cursor-to-reference, showing the time difference between the cursors,
- cursor-to-trigger time difference,
- reference-to-trigger time difference,
- risetime,
- frequency and period,
- phase measurements.

All these measurements can be performed with an excellent resolution of up to 25 ns in a single shot. Up to four measurements can be performed on a single waveform or alternatively, measurements can be performed on up to four different waveforms at the same time. The result is a versatile and powerful facility for channel-to-channel measurements and comparisons of measured parameters.

These extensive, high resolution measurement capabilities allow the PM 3308 to easily replace separate instruments like precision multimeters and counters in any engineer's toolkit.

Powerful Signal-Display Functions

Versatile functions allow detailed signal display and examination, making maximum use of the available information. For example, for detailed viewing of a part of the trace, simply set the cursor on the section to be examined and zoom in. Also provided is a separate function which separates X-Y plots and traces made against the timebase.

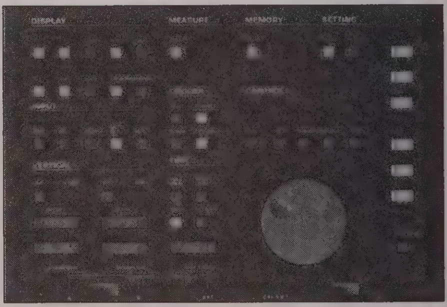
Gaps between samples can be filled by linear interpolation of the available displayed points. Sine interpolation can generate a best-fit sinewave for as few as three points, while simple pulse interpolation is also provided.

GPIB/IEEE-488 and RS 232C Interfaces Standard

Both GPIB/IEEE-488* and RS 232C interfaces are built-in as standard, providing maximum flexibility in interconnection. The IEEE-488 interface allows the PM 3308 to be used in automated test systems environments, while the RS 232C serial interface supports connection to a PC for easy down loading of measurement data or simple remote control of the instrument. In addition, both these interfaces can be used for direct connection to a digital plotter, providing instant hard-copy documentation of captured or computed waveforms.

***Information area:** displays the instrument settings and results from measurements*

- *The trace section has a clear 6.4 x 8.8 graticule*
- *This menu appears if a horizontal cursor measurement is selected. Once the final selection has been made the menu pops-down again for a clear view of the waveform*
- ***Trace 1:** Input from Channel A, Attenuator 8V/div*
- ***Trace 2:** Input from Channel B, Attenuator 2V/div*
- ***Trace 3:** Result of YA*YB, notice dimension*
- ***Trace 4:** Trace recalled from memory*
- *Timebase setting 1 ms/div.*
- *DC trigger level 0.0000V; source Channel A; AC coupled*
- *Voltage difference between cursor and zero-crossing on Trace 1*
- *Voltage difference between cursors on Trace 2*
- *Frequency of Trace 4*
- *Risetime of Trace 1*
- *Current date and time*
- ***Clear on-screen information:** three separate areas for at-a-glance readout. This display area measures 192 x 96 mm*



Clear control layout: keys grouped together by type of function; different colors for softkey functions.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3308

Specifications

Technical Specifications

Autoset: Sets display, text, vertical mode, horizontal mode and trigger coupling in a predefined position. Other parameters are set depending on signal, so that signals at inputs are all correctly recorded and displayed.

Signal Acquisition

Sampling Type: Real time 1 µs/div...1 hour/div. (Half time resolution in dual channel operation at 1 µs/div). Equivalent time 10 ns/div...0.5 µs/div
Maximum Sampling Rate: Real time sampling 40 Megasamples/s in single channel operation; 20 Megasamples/s in dual channel operation. Equivalent time 4 gigasamples/s
Vertical (Voltage) Resolution: 8 bits or 0.4% of full range: 7 bits at 5 mV/div

Horizontal (Time) Resolution:
Single channel acquisition:
MaxMem off: 512 samples/acquisition
MaxMem on: 1 µs/div...1 hour/div at 8192 samples/acquisition;
10 ns/div...0.5 µs/div at 512 samples/acquisition
Dual channel acquisition:
MaxMem off: 512 samples/acquisition
MaxMem on: 1 µs/div...1 hour/div at 4096 samples/acquisition;
10 ns/div...0.5 µs/div at 512 samples/acquisition
Acquisition Time: In Real Time mode, time needed to acquire signal +250 ms. Minimum in Equivalent time 350 ms (Depends on input frequency)
Sources: Channel A and Channel B
Acquisition Modes: Channel A only; channel A and channel B; average; glitch detection
Time Skew Samples Channel A/Channel B: In Real Time, 25 ns; in Equivalent Time Simultaneous

Channels A and B

Input Connector: BNC with probe read-out
Input Impedance: 1 MΩ in parallel with 35 pF
Input Coupling: AC, DC or GND. (In GND position: channel input disconnected from BNC and connected to ground. Zero calibration of channels when both channels are grounded.)
Max. Input Voltage: 200V
Deflection Coefficient: 5 mV/div...5V/div in a 1-2-5 sequence of 10 steps. Error limit overall ±1.5%; up to memory ±1.5% (add ±3.5% in Equivalent time mode (2x at 5 mV/div)). Non linearity according to IEC 351 1.5%
Dynamic Range: ±6.2 div
DC Offset Control: -3 div...+3 div in 1/2 div steps

Frequency Response:
Lower transition point of BW:
Input coupling in DC position - DC
Input coupling in AC position - ≤5 Hz
Upper transition point of BW (-3dB):
In Equivalent time - ≥100 MHz
In Real time - ≥5 MHz; (^{z}source = 50Ω; channel input terminated with 50Ω)
Bandwidth Limiter: Starting point of HF rejection at 5 MHz (-3 dB); slope 6 dB/octave
Pulse Response: Rise time 3.5 ns (calculated from bandwidth x rise time = 0.35)
Common Mode Rejection Ratio: At 1 kHz, 100:1 (in Real-time); at 50 MHz, 10:1 (in Equivalent time)
Spurious Signals: Noise <0.25 div or 3 mV (whichever is greater). Add 0.15 div or 4 mV in Equivalent time
Glitch Detection Function: 100% detection of pulses with width 10...50 ns
Average: Constant 10, 100, 1000, 10000 in block or continuous mode
Cross Talk: <-40 dB at 1 MHz; <-30 dB at 50 MHz

Time Base

Modes: Recurrent, Single shot, Roll

Time Coefficients
In recurrent mode: 10 ns/div...200 ms/div
In single shot mode: 1 µs/div...200 ms/div
In roll mode: 500 ms/div...1 hour/div
Error limit: In Equivalent time mode ±3%; In Real-time mode 20 ppm/°C

Triggering

Sources: Channel A, channel B, EXT, EXT/10, line, manual
Input Connector: BNC
Input Impedance of EXT Trigger Inputs: 1 MΩ in parallel with 35 pF
Coupling: Internal DC; External DC, AC, LF rejected, HF rejected, AC-HF rejected, TVF
Mode: Recurrent auto, recurrent triggered
Max. Input Voltage: 200V(DC + AC peak)

Signal Trigger Sensitivity:
Channel A or B:
In Real time hysteresis setable from 1% (0.05 div) to 50% (3.2 div)
In Equivalent time at 100 MHz - ≤2 div
In Equivalent time at 20 MHz - ≤1 div (2x at 5 mV/div.)
EXT: at 100 MHz - ≤500 mV; at 20 MHz - ≤300 mV
EXT/10: at 100 MHz - ≤5V; at 20 MHz - ≤3V
Slope Selection: Pos or neg
Signal Level Control Range: Channel A or B ±(3.2 div-2 lsb); EXT ±2.5V; EXT/10 ±25V

Frequency Response
Lower transition point of BW:
Trigger coupling in DC position - DC
Trigger coupling in AC position - ≤5 Hz (-3dB)
Trigger coupling in LF REJ pos. - 30 kHz (-3dB)
Higher transition point of BW:
Trigger coupling in HF REJ pos. - 50 kHz (-3 dB)

Trigger Delay
Real time sampling mode:
Range if MaxMem off: -12.7...+999 div
Range if MaxMem on: -204.8...+ 999 div (ZOOM=1)

Equivalent time sampling mode:
Fixed delay of 1 div + approx. 35 ns; delay value measured in autocal sequence and displayed in divisions

Memory

Memory Size: Max. record depth 8 kbytes (4 kbytes per channel in dual channel); storage memory for traces and settings 180 kbytes
Functions: Write, Lock, Select

Display

Display Medium: 191.9 cm x 95.9 cm rectangular electroluminescent display with 0.275 mm x 0.225 mm pixel size
Display Modes: Up to 4 traces; definition of traces: Channel A, Channel B, memory, addition, multiplication, subtraction, division, integration, differentiation and smoothing; interpolations - linear, sine, pulse, off. Display expansion: horizontal (X-ZOOM) - 0.05x, 0.1x, 1x, 10x; vertical (separation) - 1x, 0.5x, 0.33x, 25x (depends on number of traces); X vs Y: trace 1 vs trace 2 and/or trace 3 vs trace 4; graticule: can be switched on/off; cursor and reference cursor: tracking on/off switch

Calculation Facilities

Number of Free Definable Measurements: 4
Sources: Trace #1, #2, #3, #4, trace #1/trace #2, trace #1/trace #3, trace #1/trace #4, trace #2/trace #3, trace #2/trace #4, trace #3/trace #4
Vertical Functions: Voltage difference, peak-peak, RMS, DC-level, mean, cursor-zero, reference-zero, voltage 10% to 90%, voltage 50%, MAX, MIN, ratio RMS (lin), ratio RMS (dB), ratio voltage (lin), ratio voltage (dB)
Horizontal Functions: Cursor-reference, cursor-trigger, reference-trigger, rise time 10% - 90%, frequency, period, phase

Cursor and Reference Cursor

Horizontal Resolution: In single channel mode 1 : 8192; in dual channel mode 1: 4096
Vertical Resolution: 1: 256
Read Out Resolution: 5 digits

Calibrator

Square Wave
Internal Impedance: 450Ω ±5%
Output Voltage: 5V ±3% (peak to peak)
Output Current: 10 mA ±5% (peak to peak)
Frequency: 1 kHz ±10%

PM 3308

Communication Interfaces

IEEE-488 Interface:
Type of Interface: ANSI/IEEE Std.488-1978
Connector: RFI/EMI shield connected to pin 12
Bus Drivers: E2 (Three-state)

Interfacing Function Repertoire:

Source handshake	SH1	complete capability
Acceptor handshake	AH1	complete capability
Talker	T5	Basic Talker Serial Poll Talk only Unaddress if MLA
Listener	L3	Basic Listener Listen only Unaddress if MTA
Service request	SR1	Complete capability
Remote local	RL1	Remote, Local, Local Lock-out
Parallel poll	PP0	No capability
Device clear	DC1	Complete capability
Device trigger	DT1	Capability
Controller	C0	No capability

Address: 0...30, indicator in EL display, default address 8
Source Handshake Timing: First source time (T_{sc1}) ≥2 µs, Source time (T_{sc}) ≥0.5 µs
Acceptor Handshake Timing: Accept time (T_{ac}) ≤0.65 µs, Ready time (T_{rd}) ≥0.02 µs

RS-232C Interface
Connector: RFI-EMI
Current Output: ≤10 mA
Impedance: Output 300Ω, input 3...7 kΩ
Voltage: Output 10...+10V, input -25...+25V

Interfacing Function Repertoire
Baud Rate: 50, 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600
Number of STOP-Bits: 1 or 2
Parity: odd, even or none
Character Length: 7 or 8
Transmission Mode: Asynchronous, full duplex handshake
Software XON/XOFF or OFF
Hardware DSR/DTR or CTS/DTR

Serial poll	ESC 7
Go to Remote	ESC 2
Go to Local	ESC 1, ESC 3
Device Clear	ESC 4
Device Trigger	ESC 8

Front Panel Control
Modes: Local, remote-locked
Push Buttons: Command and question
Continuous Control: Command and question
Probe Identification: Question only
Text on EL-Display Control: Command and question; modes: graticule On/Off; combined text: signal trace, settings read-out, cursors and calculation
Cursor Control: Command and question; resolving power 1:8192 max

General Specifications

Power Supply

Source Voltage AC (rms): Nominal 100...240V: limits of operation 90...264V
Source Frequency: Nominal 50...400 Hz: limits of operation 45...440 Hz
Maximum Power Source Interruption: At least 2 ms
Power Consumption (AC Source): Nominal 90 W

Other

Data and Settings Retention:
Memory Back Up Voltage: 2...<3.9V
Memory Back Up Current Drain: typically 130 µA
Batteries: 3pcs NiCd IEC: KR-15/51
Retention Time: typically 150 days
Temperature Range: 0...+55°C

Digital Plot Output
Connector: IEEE-488 or RS 232
Function: screen dump
Languages: HPGL and Philips GL
Paper Size: A3 (B) and A4 (A)
Real Time Clock: Display of seconds, minutes, hours, days, months (battery buffered). Year, century (remote controlled)
Autocal: Calibration of zero of both channels; determination of delay in equivalent time

Mechanical

Size: 122 mm H x 276 mm W x 410 mm D (4.8 in H x 10.9 in W x 16.1 in D)
Weight: 6.5 kg
Operating Position: Horizontal (standing on feet)
Cooling: Fan aided convection

Environmental

Temperature
Rated Range of Use: +15...+35°C (max. RH 75%)
Operating: 0...+50°C
Storage: -40...+75°C (EL-display -25...+70°C)

Maximum Humidity
Operating: 75% Relative humidity
Storage: 95% Relative humidity

Maximum Altitude:
Operating: 4.5 km (15000 feet)
Storage: 12 km (40000 feet)

Vibration (Operating):
Freq. 5...15 Hz: sweep time 7 min, excursion (pk to pk)
1.5 mm, max acceleration 7 m/s² (0.7g)
Freq. 15...25 Hz: sweep time 3 min, excursion (pk to pk)
1.0 mm, max acceleration 13 m/s² (1.3g)
Freq. 25...55 Hz: sweep time 5 min, excursion (pk to pk)
0.5 mm, max acceleration 30 m/s² (3.0g)
Resonance dwell: 10 min

Shock (Operating): Total 18 shocks, 6 on each 3 axes: shock wave form half sine, duration 11 ms, peak acceleration 300 m/s2 (30g)
Bench Handling:
Meets requirements: MIL-STD-810 method 516, proced. V, Salt atmosphere, structural parts meet requirements: MIL-STD-810 method 509, proced. I, salt solution 20%
Safety: Meets requirements of: IEC 348 Class I
Included with Instrument: One 10:1 10 MΩ passive probe with read out, operating manual, programming manual

Ordering Information

Model

January 1989 prices

PM 3308/003 100 MHz Flat Display Digital Storage Oscilloscope	$7500

Accessories

(See page 53)

Passive Probes	
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8924/20 1:1 Probe, cable length 8 ft (2.5m)	60
PM 8926/29 10:1 Probe, cable length 8 ft (2.5m)	80
PM 8933/101 10:1 Probe, cable length 5 ft (1.5m)	100
Active Probes	
PM 8943Q FET Probe	850
PM 8940/09Q High Voltage Isolation Probe	850
PM 9355/09Q AC Current Probe	1000
Other Accessories	
PM 9051 BNC to 4 mm Banana Binding Posts	9
PM 2295/05 IEEE-488 cable length 1.5 ft (0.5m)	150
PM 2295/10 IEEE-488 cable length 3 ft (1m)	155
PM 2295/20 IEEE-488 cable length 6 ft (2m)	170

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3350 & PM 3365

GPIB
IEEE-488

RS-232

PM 3350

PM 3350 50 MHz, 100 MS/s Advanced Digital Storage Oscilloscope

- Dual digital and analog oscilloscope functionality in one
- Simultaneous sampling on both channels up to a high 100 MS/s
- 50 MHz analog bandwidth
- Triggering up to 100 MHz
- Autoset for instant on-screen trace display in both operating modes
- Cursors for measuring dV, dt, automatic rise/fall time, frequency and amplitudes
- Deep 4k reference memory for direct waveform comparison
- Interface options for remote control or screen hard copy via plotters or printers

Analog and Digital

The PM 3350 is the answer to many DSO measurement requirements, offering a combination of the best of real-time and digital storage oscilloscope technology. PM 3350 is designed as a high power digital storage scope for capture and analysis of single events and repetitive signals. It also has real-time capabilities that are needed or convenient in some applications, with an analog bandwidth of 50 MHz. (And the PM 3365, on page 43, expands this to 100 MHz, while adding other significant product enhancements.)

As a true "combi-scope", the PM 3350 is not simply an analog scope with "add-on" digital features, but rather is a fully implemented DSO with real-time capability. The PM 3350 sampling rate "benchmark" is a very high maximum 100 Msamples/s for each channel simultaneously. This high sampling frequency allows storage of fast signals with excellent resolution. Maximum single event resolution is 10 ns.

Analog Shift Register

The PM 3350 uses a P^{2}CCD (or Profiled Peristaltic Charge Coupled Device), a solid state combination of a fast track-and-hold input circuit and an analog shift register. Momentray values of input signals in analog samples are captured with intervals as short as 10 ns (100 Msamples/s clock). After triggering, these samples are presented to an accurate, successive approximation A/D at a much slower 100 ksamples/s. Digitizing is thus internally a low frequency operation, giving high resolution, yet not sacrificing the very high data capture rate of 100 Msamples/s. This ensures single shot events are captured and displayed to a bandwidth of over 10* MHz, such as in destructive testing or power device switching transients. Indeed, the fast sampling rate of PM 3350 brings an unparalleled break-through in DSO performance in this price range.

Simultaneous Sampling

Unlike many DSO's in the PM 3350's class, the maximum sample rate is maintained even when both channels are in use. It's essential that sample rate is not reduced in two channel acquisition, because sample rate determines the effective single shot bandwidth, and this is one of the critical specifications for a DSO. The PM 3350 offers full 100 MS/s on both channels simultaneously, which also means no time errors are caused by sample multiplexing in capture from channel to channel. Furthermore, the resolution is maintained at a very high 10 ns.

Extending single shot applications further, the PM 3350 incorporates a multishot capability, thanks to its expanded memory, as described below.

Deep Memory

A lower timebase settings, signals measured at speeds up to 5 ms/div, are stored in a 4kbytes x 8-bit memory. Data from the memory can be transferred to a second 4kbytes x 8-bit memory by one keystroke, permitting separate storage of channels A and/or B. This allows storage and display of reference waveforms while at the same time, capturing and displaying live signals from the device under test. Up to 4 traces may be stored and displayed at any one time.

This expanded memory has the added benefit of allowing multishot signal capture and display. The second reference memory effectively doubles single shot memory dept, by first capturing a single shot in the acquisition memory. Then it is dumped into the reference memory. The scope re-arms and takes the next incoming signal, so capturing 2 events. These signals may be close in time (within 50 ms) or may be many hours apart. Combined with the high sample rate, this flexibility is a great help in tracking down elusive intermittent faults.

Low Frequency Signal Registration

As well as fast signal capture, the PM 3350 has a roll made with sweep speeds down to 50 s/div giving a visual display lasting 8 minutes, allowing low frequency phenomena to be studies. The signal can be frozen at any time by pressing a single button. This is useful for study of chemical or biological reactions and responses, for example, or for slow mechanical "wear and tear" cycling. In fact this roll facility, can be used in a similar way to a paper and pen recorder.

Triggering Functions

The PM 3350 has a selection of powerful trigger capabilities, including Automatic, Manual and Single shot settings. In addition, microcomputer control supplies a built-in intelligence that completely eliminates operator adjustment in auto-triggering mode, making operation simpler and more accurate. TV line and frame for positive and negative video, alternate, auto P-P or DC, ext. and line trigger are all included in the triggering facilities, which has a wide 100 MHz bandwidth.

With 10 datapoints/period.

PM 3350 & PM 3365

Pre-trigger and Post-trigger Delay Capabilities

A major advantage of a digital storage scope is its ability to define precisely the portion of the waveform to be captured before or after the trigger. The PM 3350 has a pre-trigger capability of up to 10 divisions, allowing events leading up to the trigger moment to be captured and viewed. For example in transient waveforms, the whole of the leading edge may be recorded rather than just from the trigger moment on. This capability prevents signal detail prior to the trigger moment from being missed and is an important feature in the analysis of destructive tests. Furthermore, the PM 3350 has a capability of posttrigger (i.e. the time delay after the trigger point) for up to 250 divisions. Thus, records of over 25 screens width of information can be captured and displayed.

Low Level Signals

In mechanical applications where very low level signals are not unusual, the 2 mV/div facility allows direct input to the memory from, for example, a transducer.

X-Y Displays

Analog mode can be used for the display of X-Y diagrams. Filter curves, lissajous figures and other similar phenomena which are not time-related, but have other reference voltages, can be displayed for further analysis.

GPIB/IEEE-488 or RS 232C Interface

Signal transfers between the PM 3350 and a controller are possible via GPIB/IEEE-488* or RS 232C interfaces, for data processing, digital plots and mass storage.

Documentation and Hard Copies

The PM 3350 has several options for making hard copies of waveforms, with a built-in analog output to drive an X-Y recorder. A pen lift control is also provided. Digital plotters can be driven directly via the optional IEEE-488 or RS 232 ports. Philips PM 8155 and HPGL compatible plotters are supported by the PM 3350. The interfaces port is directly compatible with some dot-matrix printers, such as the Epson FX 80 HP Thinkjet® and compatibles.

® HP Thinkjet is a registered trademark of the Hewlett Packard company.

Ergonomic Design

Much attention has been paid to the operator interface on the PM 3350. All the innovations on the Philips 60 MHz and 100 MHz oscilloscopes are utilized in the PM 3350, resulting in a front panel layout that is much clearer, simpler and easier to use than on conventional scopes. Significant and new features are:

- LCD panel for direct read-out. The LCD panel is directly alongside the screen and gives a clear, at-a-glance alphanumeric read-out of settings, eliminating the need to look at control positions set on a crowded textplate.
- Fast-action up/down controls. Ranges and settings are entered by fast, fingertip-action controls.
- Menu-driven softkeys. Functions such as timebase and trigger settings are softkeyed, with a step-through function sequence. Selected functions are clearly indicated at all times on the LCD panel.
- Logical panel layout. Variable settings like Y-pos. and X-pos., trigger levels and hold-off are grouped together on the right of the front panel; display settings are grouped on the left of the CRT. The result is a clear panel layout that simplifies and speeds operation.

Autoset

Accessed by a single button, this function allows instant setting of all scope parameters for any input signal, eliminating time-consuming manual range finding and fine adjustment. AUTOSET operates in the Digital Storage mode, as well as when operating in the Real Time mode. Combined with the ergonomic design, the PM 3350 really offers true ease of use.

Signal Handling

The PM 3350 features extensive signal handling and measurement capabilities. It has clear on-screen softkey menu structures that permit quick access to a wide variety of measurements, by means of two independent cursors. These cursors allow the usual dV (voltage difference between cursors) to be performed, and further extend the range of automatic measurement facilities. In addition, the cursors offer measurements of signal frequency, rise and fall times and peak-to-peak voltage of the captured waveform, and can be performed live.

Other signal handling capabilities include a unique function called "RESTART". This function allows the user to zero in on a specific part of the signal, simply by positioning the cursors on either side of the portion of the waveform of interest and pressing the RESTART key. The result is the reacquisition of the signal at full resolution (not just expansion which yields no further signal information), with a digital delay and timebase calculated from the position of the cursors. To complement the signal handling, there is a further signal expansion possibility up to a factor 32.

Modular Design, Easy Service

The modular design and construction of the PM 3350 DSO provides exceptional component accessibility, making service fast, simple and low-cost. Swing-up PCBs allow easy access and removal is straightforward, due to the plug-in flat ribbon cable connections. Repairs in the field are quickly performed by simply replacing damaged modules. A complete, built-in software-driven test routine assures correct operation within minutes via on-screen test displays with instruction text.

Automatic testing

The modular construction brings another benefit - thorough testing, at module level for the first time, before building into a complete instrument. Each module passes through a computerized test station where it is given a complete functional test and adjustments are made. There is thus no chance of a complete instrument containing a faulty module. As a check, complete instruments have to pass a test routine, an extended burn-in period and then, a final series of tests. Thus, through such a rigorous test procedure, last minute defects are eliminated ensuring a long, trouble-free service life for the instrument.

Specifications and Ordering Information — see PM 3365

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3350 & PM 3365

GPIB
IEEE-488

RS-232

NEW

PM 3365

PM 3365 100 MHz, 100 MS/s Advanced Digital Storage Oscilloscope

- Dual digital and analog oscilloscope functionality in one
- Full PM 3350 performance, including simultaneous 100 MS/s sampling on both channels, deep memory and AUTOSET
- Analog and digital repetitive bandwidth to a full 100 MHz
- Systems compatability
- Triggering up to 150 MHz for improved stability
- Advanced cursors for automatic measurements of RMS, Vpp, Mean, Absolute, Frequency, Period, Pulse Width, and Rise/fall time
- Dual timebase referencing, with Autozoom

The PM 3365 brings additional DSO and real-time functionality to the PM 3350 range of oscilloscopes. It offers all the same capabilities as found in the PM 3350 - Roll mode for low frequency signal capture, the same single shot capture facilities and the same ease of use. But the PM 3365 now adds more through higher bandwidth, repetitive sampling and more capture and analysis power. The PM 3365 is the big brother of the popular PM 3350, a DSO for extended applications.

Double Performance

The new PM 3365 extends the performance standard for the popular 'combi-scope', the term which describes a full capability Digital Storage Oscilloscope and conventional analog real time scope in one unit. A high performance 100 MHz bandwidth for both analog and digital operation is complemented by a fast 100 MS/s sampling rate, the same as for the PM 3350, for single shot capture resolution of 10 ns. This combination gives exceptional capture and analysis capabilities to crack tough measurement problems.

With its advanced features, the PM 3365 is a powerful systems instrument, offering all the advantages of digitizing: long term storage of waveforms for future reference; transfer of waveform data; and automatic waveform parameter extraction, either internally through the PM 3365's built-in measurement calculations or externally via a remote systems controller.

Repetitive Sampling

While the sample rate determines the single shot capabilities of a DSO, sequential repetitive sampling is needed to digitize recurrent signals up to the full 100 MHz bandwidth. Here the digitized signal is built up over successive sweeps of the incoming signal; on each sweep a sample is taken until the memory is completely filled and the cycle begins again. The PM 3365 uses this sequential sampling technique to provide a 100 MHz capture bandwidth, mirroring the analog capabilities. All the benefits of digitized signals can then be harnessed to give measurement and analysis capabilities to 100 MHz and beyond, including constant light output over all timebase ranges even at 20 ns/div. With an equivalent time sample rate of 2.5 Gs/s, expansions up to x32 enable small signal details to be accurately examined.

Sensitive To Your Needs

The input sensitivity of PM 3365, over the full 100 MHz bandwidth, cover almost every application. This gives µV resolution in results, pinpointing those small signal variations. Couple this with a 1.2 division trigger sensitivity at 100 MHz and you have stable wideband low level signal capture. If you want even more speed, the trigger capabilities are specified all the way up to 150 MHz and you have in addition all of the excellent trigger facilities as found in the PM 3350.

Advanced Cursors

Analysis of captured signals couldn't be easier than with the PM 3365. As for the PM 3350, the same independent cursor control allows you to position two cursors to perform measurements on exactly the part of the waveform of interest. With signal tracking cross-hair cursors, parallax errors and the inconvenience of manual measurements are eliminated. No calculations are needed; signal voltages and time differences are read directly from the crisp, clear display and the PM 3365 adds the all important pulse characterization measurements including signal frequency, period, pulse width and rise and fall times. Amplitude can be measured as peak-peak, RMS, mean and absolute voltage referenced to signal ground.

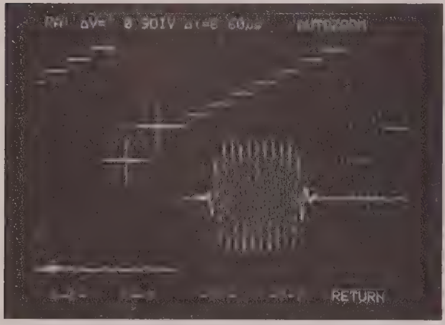
This advanced performance is easily accessed, through intuitive softkey menus, and simply executed in most cases with a single push of a button. Remote control allows access to distributed computing power; the scope will itself analyze trace data for waveform measurements and return the result.

Delayed Timebase Referencing

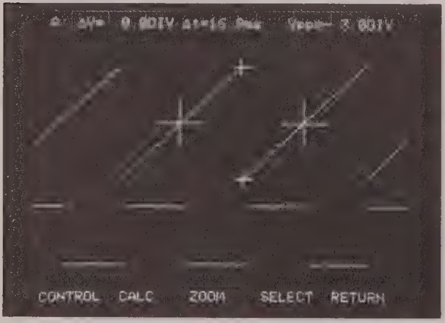
When examining fine detail within a signal cycle, it is necessary to expand the section of interest while maintaining a complete cycle display. Analog scopes do this by delayed sweep, where the main timebase (MTB) is slow and the delayed timebase (DTB) follows at a much faster speed, to give greater time resolution on a specific part of the signal. To see any part of the wave in detail and not just a portion from the trigger point on, the second timebase sweep is delayed by a user-specified time interval relative to the MTB. The time reference of the detailed part to its position in the cycle is displayed on the MTB waveform by an intensified zone.

PM 3350 & PM 3365

In the PM 3365, a similar function is available with the AUTOZOOM feature. A waveform is stored in the reference memory and displayed on screen, and acquisition takes place over a portion of the waveform, defined by cursors positioned by the user on the reference. If the cursors are moved towards each other, the acquisition timebase is automatically increased or 'zoomed' and so resolution and sample rate are higher only in the area between the cursors. For examination of any point, both cursors can be tracked together left and right across the screen over the reference trace, delaying acquisition to that point. This innovative delayed timebase referencing makes signal capture and analysis fast, efficient and simple.



Delay Time Referencing enables a burst within a video signal to be examined while still displaying the complete signal. This is directly equivalent to the delayed timebase function on an analog oscilloscope.



Automatic Pk-Pk measurement between main cursors. The secondary cursors indicate where the positive and negative peak measurement is made.

Complete Ease of Use

All the PM 3365 functions are easy to use in all applications as the same logical control found in the PM 3350 is used in the PM 3365. The AUTOSET push button gives instant, optimal display of any input signal. The familiar and separate, clear LCD gives all relevant set-up information, so there is no searching of a crowded front panel.

Ease of use also comes through clear menu structures and softkey positioning on screen. You can keep your attention focused on the trace even when performing tasks such as cursor measurements. Making hard copies is still as easy with the choice between RS 232 and IEEE-488 interface options. Hardcopy to digital plotters using the HPGL and Philips GL protocols, and on printers such as the Epson FX80 and compatibles, and the HP Thinkjet is supported and accomplished at the touch of one single button.

Either interface also allows simple application in systems environments. Complete system control of all main scope functions is possible by the use of simple programming commands.

No matter what your application, PM 3365 not only offers very powerful, advanced functions but is easy-to use. These characteristics make it the ideal instrument for use in development and production environments.

Specifications

Technical Specifications

All specifications are valid for PM 3350 and PM 3365 except where expressly stated otherwise.

Analog Mode

Vertical display modes: YA, YB, InvertB, A+B, A B (ALTernate or CHOPped)
Frequency response:
PM 3365: DC...>100 MHz -3dB

PM 3350: DC...>50 MHz -3dB
(20mV/div...10V/div)
DC...>35 MHz -3dB
(2mV/div...10mV/div)
In AC lower 3dB point is <10 Hz
Risetime:
PM 3365: <3.5 ns (2mV/div...10V/div)
PM 3350: <7.0 ns (20mV/div...10V/div)
<10 ns (2mV/div...10mV/div)
Pulse aberrations: <1.5 sub. div. peak to peak (input pulse 5 div. 1 ns rise)
Deflection coefficient: 2mV/div...10V/div in 1,2,5 sequence
Error limit: ±3% continuous control between steps with > flashing in LCD as warning symbol for uncal. setting
Input impedance: 1 MΩ ± 2%; 20 pF ± 2 pF
Max. input voltage: 400V (DC + AC peak)
Dynamic range: >24 div. at 10 MHz
>8 div. at 100 MHz (PM 3365)
>8 div. at 50 MHz (PM 3350)
CMMR: 100:1 at 1 MHz
Horizontal display modes: Timebase, or XY displays using YA and/or YB (vertical) and YA, YB or Ext. (horizontal)
Timebase: 0.5s/div...50ns/div in steps of 1,2,5 sequence
Expansion: x10, fastest sweep speed 5ns/div
Error Limit: ± 3%, in x10 ± 4% continous control between steps with > flashing in LCD as warning symbol for uncal. setting

Triggering

Trigger modes: Auto (free run), non auto triggered, single sweep
Trigger sources: A,B, composite (A,B), Ext. (DC or AC), Line LCD indicates not triggered, triggered or armed status
Trigger coupling: Auto peak - peak (P-P), DC, TVF, TVL
Trigger sensitivity:

PM 3365

	Int.	Ext.
10 MHz	0.5 div	50 mV
100 MHz	1.2 div	150 mV
150 MHz	2.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level Range	±8 div	±800 mV

PM 3350

	Int.	Ext.
10 MHz	0.5 div	50 mV
50 MHz	1.0 div	150 mV
100 MHz	3.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level range	±8 div	±800 mV

Slope pos (+) or neg (-), TVF or TVL pos (+) or neg (-) video

Level view: ±4 divisions (voltage indication in LCD)
Error limit: ±0.3 divisions

X-Deflection

Deflection coefficient: via Ch A or Ch B 2mV/div...10V/div
Freq. response: DC to 2 MHz
Error limit: ± 5%
Phase shift: <3 degrees (at 100 kHz)
Ext. input impedance: 1 MΩ ± 2%; 20 pF ± 2 pF
Max. input voltage: 400V (DC + AC peak)

Digital Mode

All specifications equal to analog part unless otherwise stated
Vertical Resolution: 8 bits
Display modes: YA,YB, Invert B
Frequency response:
PM 3365: DC...>100 MHz -3dB
(2mV/div...10V/div)
repetitive sampling to full bandwidth
PM 3350: DC...>20 MHz -3dB
(2mV/div...10V/div)
real time sampling only
Horizontal Display modes: Recurrent, Single shot, Multiple shot (up to 2), Autozoom (PM 3365 only)
Timebase Recurrent:
PM 3365: 0.5s/div...20 ns/div
(repetitive sampling)
PM 3350: 0.5s/div...0.5µs/div
(real time sampling only)

PM 3350 & PM 3365

Single shot, Multiple shot: 0.5s/div...0.5µs/div
Roll: 50s/div...1s/div
Timing accuracy: ± 0.1%
Display expansion: x1...x32

Horizontal Resolution

Single channel:

50s/div...5ms/div:	4096 samples/acquisition
2ms/div...0.5µs/div:	512 samples/acquisition
2ms/div...20 ns/div:	512 samples/acquisition (PM 3365 only)

Dual channel:

50s/div...5ms/div:	2048 samples/acquisition
2ms/div...0.5µs/div:	512 samples/acquisition
2ms/div...20ns/div:	512 samples/acquisition (PM 3365 only)

Signal Acquisition

Maximum sample rate: 100 MS/s, synchronously for both channels
Equivalent time sample rate: 2.5 GS/s (PM 3365 only)
Trigger delay:
PM 3365: 10 divisions of pre-trigger
2500 divisions of post-trigger
PM 3350: 10 divisions of pre-trigger
250 divisions of post-trigger
Display expansion: x1...x32 horizontal

Memory

Storage registers: 2
No. of traces stored in each register: up to 2
Depth of acquisition memory: 4096 words
Depth of reference memory: 4096 words
Vertical resolution: 8 bits
Display modes: Ch A, Ch B, Reg B in any combination

Cursors

Horizontal Resolution
Single channel: 1:4096 over 10 divisions
Dual channel: 1 x 2048
PM 3350: 2ms/div...0.5ns/div; 1:512
PM 3365: 2ms/div...20ns/div; 1:512 (1:1024 in dot join)
Vertical resolution: 1:256 over 10 divisions
Read out resolution: 3 digits amplitude and time
Calculation functions:
PM 3365: dV, Vpk-pk, Vrms, Vmean, Vabs dt, Freq, Period, Pulse-width, Rise/fall time
PM 3350: dV, Vpk-pk, dt, 1/dt, Freq, Rise/fall time

Interface Alternatives

Analog output for XY recorders
Output level: 1 V/full memory ± 2%
Penlift: TTL (0 or 1)
Plot time/sample: 20ms...2000ms (softkey selectable)
Connector: 9 pin DIN, female
Functions: memory dump, register selectable
Output sequence: channel A first

Interface IEEE-488 (option 40)
Bus driver: E2 (three state)
Functions available: SH1, AH1, T5, L3, SR1, RL2, PP0, DT1, DC1, C0

RS 232C (option 50)
Handshake: Software XON/XOFF
Hardware DSR/DTR and CTS/DTR
Baud rate: Transmit 75...19200
Receive 75...1200
Stop bits: 1 or 2
Parity: Odd, even or no
Character length: 7 or 8 bits

Digital plot (option 40 or 50)
Language: Selectable HPGL or Philips protocol dependent on plotter type
Plotter select: Philips PM 8153/1, PM 8153/6, PM 8154, PM 8155 HP 7450, HP 7475A
Pen select: Pen 1 for Ch A
Pen 2 for Ch B
Pen 3 for Register Ch A
Pen 4 for Register Ch B
Pen 5 for graticule and alphanumerics
Plot area: Softkey selectable

Dot Matrix Printer
Screen Dump: Compatible with Epson FX80 graphics protocol or compatible, and HP Thinkjet
Drawing Area: 10 cm x 10 cm

General Specifications

Miscellaneous Display: CRT with 8 x 10 cm viewing area P31 phosphor, 16 kV acceleration voltage. Parallax free graticule with continuously variable illumination. Separate LCD for display of status information, settings etc. LCD is constantly backlit. Softkey display are on CRT for selection of menu choices.

Power supply

Line voltage range: 100V...240V AC ± 10%
Line frequencies: 50Hz...400Hz ± 10%
Power consumption: 70W

Mechanical Data

Width: 387 mm (15.2 in) incl. handle
350 mm (13.8 in) excl. handle
Length: 530.5 mm (20.9 in) incl. handle and knobs
518 mm (20.4 in) incl. handle excl. knobs
455.5 mm (17.9 in) excl. handle incl. knobs
433.5 mm (17.1 in) excl. handle and knobs
Height: 146.5 mm (5.8 in) incl. feet
134.5 mm (5.3 in) excl. feet
Weight: Approx. 9.5 kg (20.9 lbs) excl. accessories

Environmental Data

The PM 3350/65 are designed to meet the requirements of MIL-T-28800 C, Type III, Class 5, Style D

Temperature
Rated Range of use: +10°C...+40°C
Limited Range of Operation: 0°C...+50°C
Storage: -40°C...+75°C

Altitude
Operating: 15,000 ft (4,500 m)
Non-operating: 40,000 ft (12,000 m)
Humidity: 95% RH
EMI: MIL-STD-461 CLASS B VDE 0871 VDE 0875 Grenzwert klasse B
Safety: Meets requirements of IEC 348 Class 1, VDE 0411, UL 1244, CSA 556 B
Shock: Operating and Non-operating: 30 g, 1/2 sine, 11 ms duration, 6 shocks in each direction (3 each face), for a total of 18 shocks
Vibration: 5...55 Hz, 15 minutes along each of three axes, with a maximum acceleration of 3 g Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found
Bench handling: MIL-STD-810 method 516, procedure V

Included: 2x PM 8926/09 Passive 10:1 probes with 5 ft (1.5 m) cable and scale factor readout, Blue CRT contrast filter, Operating Manual

Ordering Information

Models

January 1989 prices

PM 3350 100 Ms/s, 50 MHz Digital Storage Oscilloscope	$3990
PM 3352 Same, with rackmount	4115
PM 3365 100 Ms/s, 100 MHz Digital Storage Oscilloscope	4990
PM 3367 Same, with rackmount	5115

Optional Configurations

When ordering, select the basic "PM" model from above, and add the configuration option number listed below as a suffix.

/003 Basic configuration	N/C
/403 Basic configuration, with IEEE-488 interface	add 500
/503 Basic configuration, with RS 232 C interface	add 500

Example, Ordering Information
To order a 100 MHz, 100 Ms/s Digital Storage oscilloscope in rackmountable configuration, with GPIB/IEEE-488 interface installed, select:

Basic oscilloscope	PM 3367	$5110
Configuration option suffix	/403	500
Complete model number	PM 3367/403	5610

PM 3350 & PM 3365

Accessories (See page 53)

Passive Probes

PM 8922/501 1:1 or 10:1 Probe, cable length 5 ft (1.5M)	$50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5 m)	60
PM 8924/20 1:1 Probe, cable length 8 ft (2.5 m)	60
PM 8926/09 10:1 Passive Probe with readout, cable length 5 ft (1.5 m)	80
PM 8926/29 10:1 Passive Probe with readout, cable length 8 ft (2.5 m)	80
PM 8926/501 10:1 Probe, cable length 5 ft (1.5m)	50
PM 8926/591 10:1 Probe with readout, cable length 5 ft (1.5m)	60
PM 8931/09 20 MΩ, 100:1 Passive Probe with readout	135
PM 8936/09 Set of two 8926/09	125

Active Probes

PM 8940/09Q High Voltage Isolation Amplifier with readout	$850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe with readout	1000

Other Accessories

PM 8917/003 Video Sync Separator and Line Selector	550
PM 8957 Retrofittable GPIB IEEE-488 Interface	500
PM 8958 Retrofittable RS 232C Interface	500
PM 8988 Protective Front Panel Cover	35
PM 8991/04 Oscilloscope Cart	450
PM 8992/65 Accessory Pouch	45
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9076/01 DIN - 4 mm Banana Analog Plot Out Cable	60
PM 9076/02 DIN - Amphenol Analog Plot Out Cable	$60
PM 9381 Oscilloscope Camera	650
PM 2195/09 Probe Switch, 400 MHz	650
PM 2122/01 50Ω Coaxial Switch	680
PM 2230 Series Instrument Driver Software	590
PM 2240/001 TestTeam Software	925
PM 2260/001 Oscilloscope Signal Processing Software	800

Service & Support

Warranty

Three-year product warranty. See page 470 for further information on warranty terms and definitions.

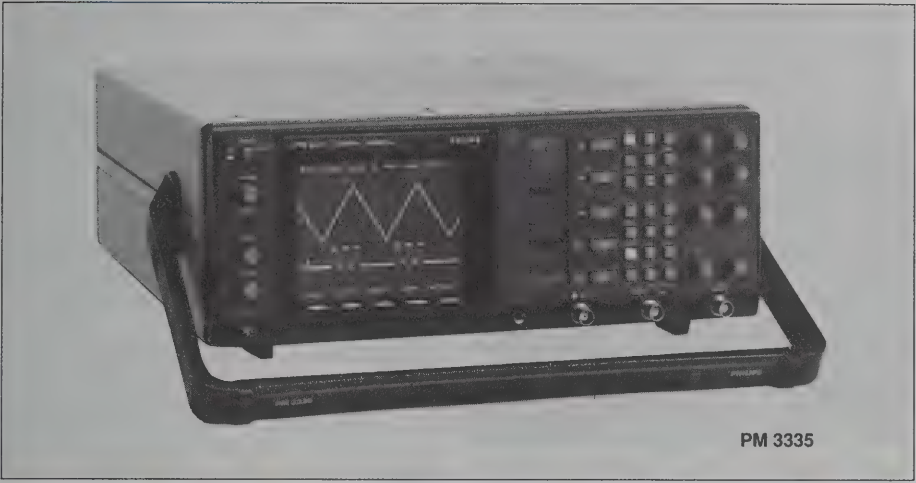
Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 3335

GPIB IEEE-488

RS-232

NEW


PM 3335

PM 3335, 50 MHz, 20 MS/s Digital Storage Oscilloscope
Analog oscilloscope plus full function Digital Storage Oscilloscope
20 MS/s sample rate on each channel simultaneously
50 MHz real time analog bandwidth
Deep 8 kbytes x 8-bit waveform acquisition memory even at max. sample rate
Second reference memory for comparison of waveforms
AUTOSET for instant on-screen trace display
Standard cursors for many on-screen measurements
GPIB/IEEE-488 and RS 232 interface options

Two Scopes in One

Philips new PM 3335 sets a standard in performance and economy. This instrument is two professional scopes in one: it operates as a real-time 50 MHz analog oscilloscope and at the touch of a button, becomes a full function digital oscilloscope for advanced applications. Now, for the first time in a cost-effective scope, you have the power for digital capture and analysis of elusive single shots with a full 20 MS/s sample rate on each channel simultaneously. Unlike some scopes in this class, the full sample rate is maintained for all channel combinations, giving a single event resolution of 50 ns for both channels. Repetitive signal analysis is also possible up to 50 MHz in analog oscilloscope mode. A x10 expansion allows 5 ns sweep speeds for detailed viewing and furthermore, with the 100 MHz trigger bandwidth, you have a higher trigger sensitivity over the full range.

Extensive Memory Capability

In a DSO, it is vital that the memory be large enough to capture all the data in the intended areas of use. The PM 3335 will be used in automotive, medical, mechanical, video and general electronics industries, as well as in education and training. Here, scopes must capture typical waveforms over a full cycle and have an adequate sample resolution to show fine details within cycle. Typical examples here are in video waveforms or engine injection cycles. With its deep 8 kbytes x 8-bit acquisition memory and 20 MS/s sample rate, the PM 3335 fully meets this requirement — indeed no other instrument in this price class has such a large memory.

For waveform comparison, a second reference memory is available. The full 8 kbytes x 8-bit memory allows storage and display of up to 2 reference waveforms. Together with the 2 live waveforms from the acquisition memory, a total of 4 waveforms can be displayed.

Measurement Cursors as Standard

Independent voltage and time cursors make signal parameter extraction both accurate and fast. Along with measurement of voltage and time differences (dV, dt), the measurement functions include selection of ratio, phase and track. To aid the user further, a simple frequency calculation is made by 1/dt.

Positioning cursors on the easily identified 10% and 90% of peak-to-peak value gives a rise/fall time readout. Cursors are particularly valuable in dc measurements where any point on the captured waveform can be measured to reference ground. This further extends use of the cursors so that readouts can show not only difference results on a single trace, but also from trace to trace.

Powerful Triggering

The PM 3335's deep memory can also be used to show extensive pretrigger information. Unlike a conventional scope, a DSO can pretrigger, i.e. capture and display events prior to a trigger. A DSO continuously acquires data until stopped by detection of a valid trigger signal, rather than starting the sweep on detection of the trigger, like an analog oscilloscope. Thus all samples captured by the DSO are effectively in "negative time" and contain pretrigger waveform information.

This function is very useful in showing, for example, the complete leading edge of a pulse waveform for rise/fall time measurement (compared to an analog scope that can only show the edge form from the trigger moment on). Another example is to examine preshoot signals or transients leading up to the trigger edge. In the PM 3335, up to 20 divisions of pretrigger information can be captured and analyzed.

Two Interfaces in One

The PM 3335 has communication facilities normally only expected in instruments in much higher price ranges. Its optional interface has both RS 232 and GPIB/IEEE-488* capability. Either can control instrument set-up and transfer waveform data in remote control applications. When combined with the increasing range of programming and control packages, the PM 3335 is ideal for automatic signal capture and analysis. In particular, the software package for Oscilloscope Signal Processing (OSP) PM 2260 enables cross-correlations, algebraic manipulations, FFT and many other manipulations on acquired traces.

Mass storage of captured waveforms is also possible via the interfaces. If the large internal memory of 8 kbytes is insufficient, connect the scope to a PC and run the OSP. Simply answer 'yes' to the prompt 'mass storage?' and the software automatically routes all captured data to external storage. Since PM 2260 is a package specifically designed for handling data from scopes, you need not become involved in making the scope communicate with the external storage — that's all done for you by OSP.

Advanced Plot and Print Capability

The PM 3335 has so many functions not usually found in competitive instruments, it should not come as a surprise that it has extensive plot and print capabilities. The plot function outputs screen copies to industry standard plotters and printers via the optional interface card. Plot language is HPGL or Philips GL, covering virtually all available XY plotters. Screen copies can also be sent to EPSON FX 80 printers or compatibles over both interfaces.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3335

Simple to Operate

While the PM 3335 offers capabilities never before seen in a cost-effective scope, this is not at the expense of ease of use. Ergonomics was a vital element in design of the instrument. All the innovations first introduced on Philips SMART scope range of 60 MHz and 100 MHz analog oscilloscopes are shared by the PM 3335. Innovations such as:

- Direct parameter read-out of the present set-up on an LCD panel for at-a-glance checking of information, avoiding the need to look at control settings on a crowded text plate.
- Fast action up/down controls give finger tip setting of range values quickly and securely. Reliability is guaranteed by cold switching through microprocessor control. All rocker keys are located directly next to the clear LCD for read-out and immediate confirmation of set-up.
- Front panel layout is logical, with similar functions grouped together for instant recognition. All controls that relate to variable settings such as Y-pos or VAR are located on the right hand side of the front panel resulting in a clear layout.
- Softkeys are positioned directly under the CRT display, mounted flush in the screen bezel. Softlabels appear on the screen just above these keys with a readily understandable menu sequence and selection. After acquisition of the signal, attention is focused on the display, avoiding mistakes that can occur when selections are out of the field of vision.

The result is an instrument that is readily understood and easy to use, while offering a versatile capability for fast problem solving.

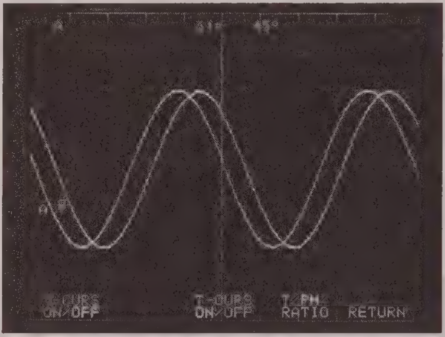
Autoranging, Autoscaling and Autoset

Another first for the PM 3335 is its full function Autoset. A single push of the Autoset button and any signal is automatically scanned and an optimum display of the trace is provided. It is not a factory preset, but is a full autoranging of timebase and amplitude parameters depending on the incoming input signal. In addition, each channel is searched for a signal and if no signals are present, that channel is not displayed to avoid confusing information. Moreover, the Autoset selects the best trigger source for maximum trace stability. No other manufacturer gives you all these facilities for such a low price.

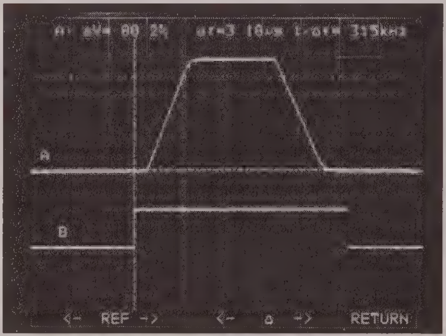
Modular Construction

The PM 3335's modular design and construction gives unparalleled serviceability. Swing up PCB's allow easy access to all circuits, for quick and efficient repair and service. Built in test routines with on screen prompts guide the service engineer quickly to the problem; and a quick check and adjust facility provides verification of the correct functioning of the instrument for reliable measurement results.

The modular construction also allows thorough testing of each module in production, before being built into the complete instrument, after which final functional tests and adjustments are made. This results in reliable instruments that give trouble free operation throughout their life.



Phase measurements between channels are quickly and accurately made thanks to the extensive cursor facilities and the simultaneous acquisition on both channels. Without this simultaneous sampling the timing difference between the channels would result in measurement faults.



Rise times or delay times between channels are simply measured using the 'four way' cursors on the PM 3335.

Specifications

Technical Specifications

Analog Mode

Vertical

Display Modes: YA, YB, -B, A+B, A-B (ALTernate or CHOPped)

Frequency Response:
DC...>50 MHz, -3 dB (20 mV/div...10V/div);
DC...>35 MHz, -3 dB (2 mV/div...10 mV/div);
AC, lower 3 dB point is <10 Hz

Risetime: <7 ns (20mV/div...10V/div);
<10 ns (2 mV/div...10 mV/div)

Deflection Coefficient: 2 mV/div...10V/div in 1, 2, 5 sequence

Error Limit: ±3%, continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting

Input Impedance: 1 MΩ ±2%;20 pF ±2 pF

Maximum Input Voltage: 400V (DC + AC peak)

Dynamic Range: >24 div at 10 MHz, >8 div at 50 MHz

CMRR: 100:1 at 1 MHz

Horizontal

Display Modes: Timebase, or XY displays using YA and/or YB (vertical) and YA, YB or Ext (horizontal)

Timebase: 0.5s/div...50 ns/div in 1, 2, 5 sequence

Expansion: x10, fastest sweep speed 5 ns/div

Error Limit: ±3%; ±4% in x10; continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting

Triggering

Trigger Modes: Auto (free run), non-auto triggered, single sweep

Trigger Sources: A, B, composite (A, B), Ext (DC or AC); line LCD indicates not-triggered, triggered or armed status

Trigger Coupling: Auto peak-to-peak (P-P), DC, TVF, TVL

Trigger Sensitivity:

	Int	Ext
10 MHz	0.5 div	50 mV
50 MHz	1.0 div	150 mV
100 MHz	2.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level range	±8 div	±800 mV

Slope: Positive or negative, TVF or TVL positive or negative

X-Deflection

Deflection Coefficient:
Via Ch A or Ch B, 2 mV/div...10 V/div;
via Ext input, 100 mV/div

Frequency Response: DC to 2 MHz

Error Limit: ±5%

Phase Shift: <3° (at 100 kHz)

Ext Input Impedance: 1 MΩ ±2%;20 pF ±2 pF

Max Input Voltage: 400V (DC + AC peak)

Digital Mode

All specifications as analog part unless otherwise stated

Vertical

Resolution: 8-bit

Display Modes: YA, YB, -B

Frequency Response: DC...>10 MHz, -3dB (2 mV/div...10V/div)

Horizontal

Display Modes: Recurrent, single shot, multiple shot (up to 2)

Timebase

Recurrent, Single, Multiple Shot: 50s/div... 10 µs/div

Timing Accuracy: ±0.1%

Display Expansion: x1...x32

Horizontal Resolution

Single Channel: 8192 samples/channel

Dual Channel: 4096 samples/channel

Signal Acquisition

Maximum Sample Rate: 20 MS/s, simultaneously for both channels
Trigger Delay: 20 divisions of pretrigger

Memory

Storage Registers: 2
Number of Traces Stored in Each Register: up to 2
Depth of Acquisition Memory: 8192 words
Depth of Reference Memory: 8192 words
Vertical Resolution: 8-bit
Display Modes: Ch A, Ch B, Reg A, Reg B in any combination

Cursors

Horizontal Resolution: (all display modes) 1:1000 over 10 divisions
Vertical Resolution: 1:200 over 8 divisions
Read Out Resolution: 3 digits amplitude and time
Calculation Functions: dV, dt, 1/dt, ratio, phase

Interface Option (40)

Contains both IEEE-488 and RS 232C capability

IEEE-488

Bus Driver: E2 (three state)
Function Repertoire: SH1, AH1, T5, L3, SR1, RL2, PP0, DT1, DC1, C0

RS 232C

Handshake: Software XON/XOFF, hardware DSR/DTR and CTS/DTR
Baud Rate: Transmit and receive 75...1200 bits/sec
Stop Bits: 1 or 2
Parity: Odd, even or none
Character Length: 7 or 8 bits

Interface Option (50)

RS 232 C data dump only
Handshake: Software XON/XOFF, Hardware DSR/DRT and CT5/DTR
Baudrate: Transmit 75 ...1200 bits/sec
Stop bits: 1 or 2
Parity: Odd, even or none
Character length: 7 or 8 bits

Digital Plot (Option 40 or 50)

Language: HPGL or Philips GL dependent on plotter type selected
Plotter Select: Philips PM 8153/1*, PM 8153/6*, PM 8154*, PM 8155, HP 7450, HP 7475A
Pen Select:
Pen 1 for Ch A
Pen 2 for Ch B
Pen 3 for Register Ch A
Pen 4 for Register Ch B
Pen 5 for graticule and alphanumerics
Plot Area: Softkey selectable
Dot Matrix Printer Screen Dump: Compatible with Epson FX80 and HP Thinkjet ® graphics protocol or compatibles
Drawing Area: 10 cm x 10 cm

**Not available in North America*

General Specifications

Display

Screen: CRT with 8 x 10 cm viewing area; P31 phosphor, 16 kV acceleration voltage. Softkey display area on CRT for selection of menu choices.
Graticule: Parallax-free with continuously variable illumination.
LCD Display: Separate constantly backlit LCD for display of status information, settings, etc.

Power Supply

Line Voltage Range: 100V...240V AC ±10%
Line Frequencies: 50 Hz...400 Hz ±10%
Power Consumption: 70W

Mechanical Data

Width: 387 mm (15.2 in) incl. handle, 350 mm (13.8 in) excl. handle
Length:
531 mm (20.9 in) incl. handle and knobs
518 mm (20.4 in) incl. handle, excl. knobs
456 mm (17.9 in) excl. handle, incl. knobs
434 mm (17.1 in) excl. handle and knobs
Height: 146.5 mm (5.8 in) incl. feet, 134.5 mm (5.3 in) excl. feet
Weight: Approx 9.5 kg (20.9 lbs) excl. accessries

Environmental Data

Temperature
Rated Range of Use: +10°C...+40°C
Operating Range: 0°C...+50°C
Storage: -40°C...+75°C

Altitude
Operating: 4500 m (15000 ft)
Transport: 12000 m (40000 ft)

EMI: Meets requirements of MIL-STD-461 class B, VDE 6871 and VDE 0875 Grenzwertklasse B
Safety: Meets requirements of IEC 348 class 1, VDE 0411, UL 1244, CSA556 B
Included with Instrument: 2 x PM 8926/09 10:1 probes (with scale factor readout), blue CRT contrast filter, operator manual, power cord.

Ordering Information

Models

January 1989 prices

PM 3335 20 Ms/s, 50 MHz Digital Storage Oscilloscope	$2495
PM 3337 same, with 19 in. Rackmount	2620

Optional Configurations

When ordering, select the basic "PM" model from above, and add the configuration option number listed below as a suffix.

/003 Basic Model	N/C
/403 GPIB IEEE-488/RS 232 Interface installed	add $500

Example, Ordering Configuration

To order the 50 MHz, 20 Ms/s Digital Storage Oscilloscope in rackmountable configuration, with GPIB IEEE-488/RS 232 interface installed, select:

	Model	Price
Basic Oscilloscope	PM 3335	$2495
Configuration Option Suffix	/403	500
Complete Model Number	PM 3335/403	2995

Accessories (See page 53)

Passive Probes

PM 8922/50 1:1 or 10:1 Probe, cable length 5 ft (1.5m)	$50
PM 8924/00 1:1 Probe, cable length 5 ft. (1.5m)	60
PM 8924/20 1:1 Probe, cable length 8 ft (2.5m)	60
PM 8926/09 10:1 Probe with readout, cable length 5 ft (1.5m)	80
PM 8926/29 10:1 Probe with readout, cable length 8 ft (2.5m)	80
PM 8926/59 10:1 Probe with readout, cable length 4 ft (1.2m)	60
PM 8931/09 20 MΩ 100:1 Probe with readout	135
PM 8936/09 Set of 2 PM 8926/091 Cables	125

Active Probes

PM 8940/09Q High Voltage Isolation Amplifier with readout	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe with readout	1000

Other Accessories

PM 9051 BNC to 4 mm Banana Adapter	9
PM 9381 Oscilloscope Camera	650
PM 8991/04 Oscilloscope Cart	450
PM 8992/65 Accessory Pouch	45
PM 8959/001 Retrofittable IEEE-488 (GPIB) and RS 232 Interface	750
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8988 Protective Front Panel Cover	35
PM 2195/09 Probe Switch, 400 MHz	650
PM 2122/01 50Ω Coaxial Switch	680
PM 2230/001 Instrument Drivers Series	590
PM 2240/001 TestTeam Software	925
PM2260/001 Oscilloscope Signal Processing Software	800

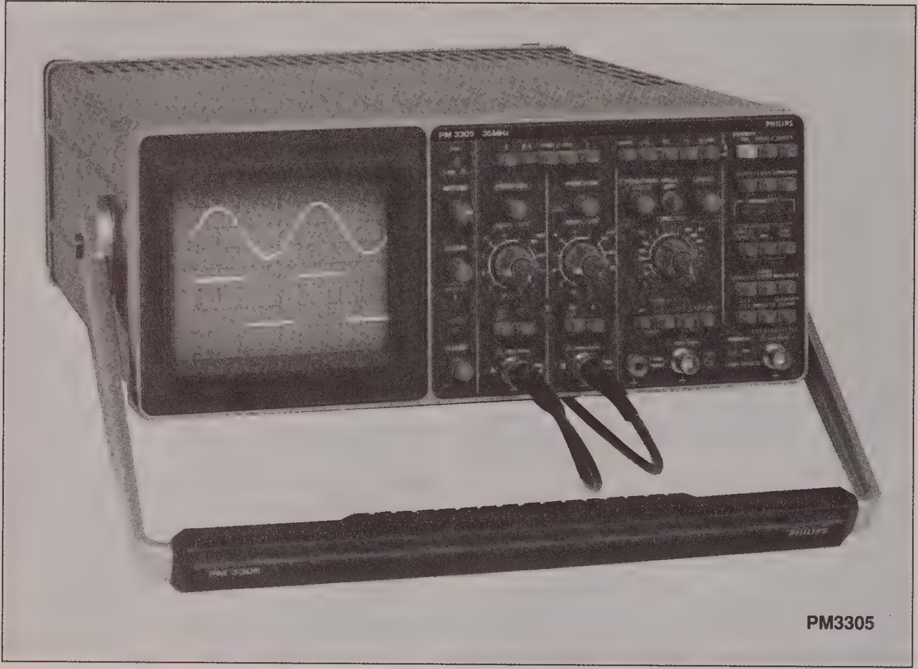
Service and Support

Three-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American requirements. For other power options, see page 491.

PM 3305

GPIB IEEE-488



PM 3305 35 MHz 4-Channel Digital Storage Oscilloscope
4 channels
Memory size: 4096 x 8 bits
Pre-trigger 4096 bits max.
MIN/MAX mode catches 10 ns glitches, displays envelopes
Analog, non-storage operation

The PM 3305 offers digital storage facilities combined with the direct display facilities of a conventional 35 MHz oscilloscope. With its four input channels, PM 3305 becomes an excellent tool for applications, in mechanical and physical environments as well as general electronics.

General Purpose

The oscilloscope offers all well-proven features for ease of operation.

These include excellent trigger facilities such as A/B/Composite/Line/10, combined with a trigger mode such as Auto/DC/AC. Moreover, the oscilloscope can be triggered from extremely complex signals. The 35 MHz vertical bandwidth for both digital display mode and digital storage mode makes the unit a universal and genuinely multipurpose instrument.

Digital Storage

If the MEMORY ON button is pressed the instrument functions as a powerful digital storage oscilloscope, offering an enormous number of measuring possibilities.

4 Channels

In the digital storage-mode, except for the standard A and B inputs, two extra floating channels are available. These extra inputs are especially useful for signals from transducers in mechanical measurements, since the input can be used as a 20 mA/cm or 200 mA/cm current input.

Low Repetition Rate Signals

In the MEMORY ON mode, with the unit functioning as a digital storage oscilloscope, on each trigger, the memory contents are overwritten. A signal with a low repetition frequency is thus displayed with high light intensity.

Link to History

During operation a COMPARE mode can be selected. The live signal is then compared with a signal previously caught in the memory. If the latest signal is better and must be used as a reference it is only necessary to release the button and depress again, and the new signal is frozen as the reference signal.

Single Events

When the SINGLE function is selected, non-repetitive signals can be captured in a time window from 2 ms up to 50 seconds. Depending on the time setting, a resolution of 500 ns can be achieved. This single shot function is combined with RESET a CLEAR function. During waiting time (indicated on a LED) the latest stored signal is visible on the screen.

When the CLEAR button has been depressed the zero reference line is visible on the screen. If the CLEAR button has been depressed twice, the zero line is no longer displayed on the screen.

Peaks and Glitches of ≥10 ns

The disadvantage of digital oscilloscopes has always been the fact the system is not looking at the signal between two sample moments. Glitches and signal peaks shorter than the sampling distance can be missed. The PM 3305 overcomes this problem by means of a built-in MIN/MAX function. In the MIN/MAX mode any pulse pulse longer than 50 ns is stored and consequently displayed at the next moment of sampling. If the pulse is shorter than 50 ns, the amplitude shown might not be representative of the real amplitude, but even a 10 ns pulse is still captured at 55% of its original level.

Modulated Signals

In the MIN/MAX mode, signals with frequency components higher than the sampling rate can be stored and displayed so that the envelope of the modulated signals can be easily made visible.

35 MHz Bandwidth

The digital storage operation does not stop at its maximum sampling frequency. From 0.1 ms/div. to 0.1μs/div., the sampling oscilloscope operates as a sequential sampling system (indicated by LED labelled "Repetitive signals only"). By using this technique, at the full bandwidth of the oscilloscope, the full range of the time base settings can be used as a storage oscilloscope with a minimum equivalent sample distance of 250 ps.

IEEE Bus Operation

The optionally available interface gives access to the digital part of the oscilloscope via GPIB IEEE-488* bus lines. This means that the complete memory or a selected part of it can be transferred to a controller and the same is valid for filling the memories with new data. Time base and all switches related to the digital part of the oscilloscope can be controlled and read by an IEEE-488 bus controller.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Hard Copies

A special version is available if copies on an analog X-Y recorder are required. The IEEE version is supplied with the necessary software to make hard copies on a digital plotter e.g. an HPGL-compatible plotter. Plot size can be switched between 8 x 10 cm and 16 x 20 cm. Moreover, the oscilloscope can be set to the single-shot mode, whereby after catching the signal a hard copy is made and the oscilloscope is ready again for the next single shot. If the plotter has automatic paper transport, a new piece of paper will be provided automatically between recordings. The IEEE version has an alternative analog output as standard.

Many Other Plus Features

Other attractive features of the PM 3305 should not be overlooked. For instance, there is the dual slope triggering, the possibility to expand a selected part of the memory four times, 10 times or even forty times. Other features include the X-Y display facility, the direct output from the A-D converter, the pre- trigger capability of 4096 bits and the possibility of external clock drive, etc.

Specifications

Technical Specifications

CRT

Type: Philips rectangular mesh-type post deflection accelerator tube with 10 kV accelerating voltage and metal backed phosphor
Screen Type: P31 (GH) phosphor standard; P7 (GM) phosphor optional
Useful Screen Area: 8 x 10 cm
Graticule: Internal graticule with centimeter divisions and 2 mm divisions along the central axes. 10% and 90% lines are indicated. Graticule illumination continuously variable.

Vertical or Y-Axis (For A and B channels)

(For C and D channels see DIGITAL STORAGE OPERATION)
Frequency Response: DC: 0 Hz...35 MHz (-3 dB); AC: 2 Hz...35 MHz (-3dB)
Rise Time: 10 ns
Deflection Coefficients: 2 mV/div...10V/div. 1- 2-5 sequence. Uncalibrated, continuous control between steps 1:>2.5
Accuracy: ±3%
Display Modes: Channel A, channel B, alternate, chopped at approx. 500 kHz, added. Channel B can be inverted
Input Impedance: 1 MΩ/20 pF
Maximum Imput Voltage: Undistorted deflection of 24 div. Shift range 16 div.
Signal Delay: ≥2 divisions at 10 ns/div.
CMR-Factor: 100:1 at 1 MHz (A-B mode with 8 div. common mode signal)

Horizontal or X-Axis

Horizontal deflection can be obtained from the main time base, or from an external source. In this case X-Y diagrams can be displayed using Y_A, Y_B, the EXT connector or the mains as signal source for horizontal deflection.
Display Modes: X-Y or X-Y/Y operation with X-deflection by Y_A, Y_B, External or Mains (line)

X-Input

Frequency Response: DC...1 MHz (-3 dB)
Deflection Coefficients: 200 mV/div. using EXT connector; 2V/div. using EXT ÷ 10 connector; Vertical attenuator coefficients apply when Y_A or Y_B is used for X-deflection
Measuring Accuracy: ±10%
Phase Error: 3° at 100 kHz

Time Base

Mode: Automatic or triggered
Time Coefficients: 0.5s/div....100 ns/div. in 1-2-5 sequence (or 5s/div...100 ns/div; see DIGITAL STORAGE OPERATION).
Uncalibrated continuous control between steps 1:>2.5
x 10 magnifier extends max sweep rate to 10 ns/div.
Accuracy: ±3%
Additional error for magnifier ±2%

Triggering

Trigger Source: Internal: Y_A, Y_B, Composite, Line; External; External ÷ 10
Slope: + or - or dual
Trigger Modes: Auto, AC, DC, TV

Trigger Sensitivity:
Internal: 1.0 div. at 35 MHz
Internal: 0.5 div. at 5 MHz
External: 0.2V pp at 35 MHz
External ÷ 10: 2V pp at 35 MHz
TV Int: 0.7 div. sync pulse
TV Ext: 0.15V pp sync pulse
TV Ext ÷ 10: 1.5V pp sync pulse

Trigger Frequency Range:
Auto: 20 Hz...>50 MHz;
AC: 5 Hz...>50 MHz;
DC: 0 Hz...>50 MHz

Trigger Level Range:
Auto: automatically adjusted between limits on signal amplitude.
Internal (AC, DC): 8 div.
External (AC, DC): 1.6V.
External ÷ 10 (AC, DC): 16V
Input Impedance: 1 MΩ//20 pF
Maximum Permissible Input Voltage: 400V (DC + AC peak)
Variable Hold-Off: Sweep hold-off time can be increased by a factor of 10.

Digital Storage Operation

Memory Data
Memory Size: 4096 x 8 bits
Pre-Trigger: 4096 samples max (adjustable in steps of 25%)
Timebase: 0.1 µs/div...5s/div.
Vertical Resolution: 256 steps over 8 cm

Horizontal Resolution:
Single trace 1:4096;
Dual trace 1:2048;
Four trace 1:1024;
Compare + single trace 1:2048;
Compare + dual trace 1:1024;
Compare + four trace 1:512
Max. Sample Frequency: 2 MHz. 1 MHz when external clock is used.

Four-Channel Operation

With the button ABCD CHOP depressed the PM 3305 operates in the four-channel mode. The signal is always captured in the chopped mode.
A and B Channels: As specified for 2-channel operation
C and D Channels: Frequency response DC... 1 MHz (-3 dB)
Deflection Coefficients: 0.1V/div. or 1V/div.
Input: Floating
Vertical Positioning: 10 divisions
Input Impedance: 10 KΩ(DC-coupled)
Max. Input Voltage: 42V (DC + AC peak)
CMRR: 300:1 at 50 kHz

Special Features

Peak Detection: Pulses with pulse width of 50 ns are captured. Pulse of 10 ns is captured at 55% of original level.
Extra Time Coefficients: In the storage mode three extra time base settings are available so that time is expanded to 5s/div.
Compare: 50% of the available memory capacity can be used for storage of a reference signal.

Display Modes

Normal or Smooth Display: Smoothed picture can be made visible.
X=A/Y=B: Signal stored in A is used as reference for horizontal display. Signal stored in B is used as reference for vertical display.
Display Expand: A selected par (1/4 of memory) can be displayed over the screen.

Digital Output

A/D Out: Output from A/D is available on external connector, 8 bits parallel. Conversion ready signal on 9th pin.
Memory Dump: (When equipped with IEEE-bus interface) Memory can be dumped via IEEE connector to external interface. Normal handshake procedure is used.

PM 3305

IEEE Bus Interface (optional): Memory contents, time base and digital oscilloscope settings can be read or be sent.
Analog Output: If the oscilloscope is equipped with an analog output, a copy of the screen can be made on paper via an X-Y recorder (full-scale hor/vert 1V). Pen lift at choice on logical level 0 or 1.
Digital Plot-Out: An option is available for digital plot-out. In combination with the Digital plotter PM 8155 a 1:1 copy of the screen can be made.

General Specification

Calibration

Voltage: 1.2V pp ±1% square wave
Frequency: 2 kHz approx.

Power

Line Voltage and Frequencies: 110, 120, 220 and 240V_{AC} ±10%, 46...440 Hz
DC Power Source: 24...27V_{DC} floating max. 2A
Power Consumption: 70W when powered from nominal line voltage
Insulation: The insulation of the power supply fulfills the safety requirements of IEC 348 CL I for metal encased instruments.
Dimensions and Weight: 337 mm W x 137 mm H x 452 mm L (13.2 in W x 5.4 in H x 17.8 in L) 10 kg (22 lb) (approx.)

Environmental Capabilities

Ambient Temperatures:
Rated range of use +5°C...+40°C;
Operating -10°C...+40°C;
Non-operating -40°C...+70°C
Altitude: Operating: to 5 000m (15 000 ft);
Non-operating: to 15 000m (45 000 ft)
Humidity: 21 days cyclic damp heat 25°C - 40°C, RH 95%
Shock: 30g: half sine wave shock of 11 ms duration: 3 shocks per direction for a total of 18 shocks
Vibration: Vibrations in three directions with a maximum of 15 min. per direction. 5-55 Hz and amplitude of 0.7 mm_{pp} and 3 max. acceleration.
Recovery Time: Operates within 30 minutes coming from -10°C soak, going into 60% relative humidity at +20°C room conditions.
Electromagnetic Interference: Meets VDE 0871 and VDE 0875 Grenzwertklasse B

Interface Functions:

SH1	Source handshake complete capability
AH1	Acceptor handshake complete capability
T5	Capabilities: Basic talker, serial poll, talk only, unaddress if MLA; Output data: settings, data; Status data: Busy/ready data, alarm conditions
L3	Capabilities: Basic listener, listen only, unaddress if MLA; Programming data: Digital settings, memory data
SR1	Complete capability of sending service request
RL2	No local lockout
PP0	No parallel poll
DC1	Complete device-clear capability
DT1	Complete device-clear capability

Included with instrument: 2 Passive 10:1 probes, blue contrast filter, front cover, Operating Manual

Ordering Information

Model

January 1989 prices

PM 3305 Four channel Digital Storage Oscilloscope	$3950

Optional Configurations

When ordering, select basic "PM" Model desired from above, and add the configuration option number listed below as a suffix.

/003 Basic model, bench version	N/C
/403 Same, with GPIB IEEE-488 I/F, includes drivers for digital plotters and analog output for analog XY recorder	add 500
/703 Basic model with analog output for analog XY recorder only	add 275

Example, Ordering Configuration
To order a 35 MHz Digital Storage Oscilloscope with GPIB/IEEE-488 and analog XY recorder output, select:

	Model	Price
Basic Oscilloscope	PM 3305	$3950
Configuration option suffix	/403	500
Complete Model Number	PM 3305/403	4350

Accessories (See page 53)

Passive Probes	
PM 8922/501 1:1 or 10:1 Probe, cable length 4 ft. (1.2m)	$50
PM 8924/00 1:1 Probe, cable length 5 ft (1.5m)	60
PM 8926 10:1 Passive Probe, cable length 5 ft (1.5m)	70
PM 8926/20 10:1 Passive Probe, cable length 8 ft (2.5m)	70
PM 8926/501 10:1 Probe, cable length 4 ft (1.2m)	50
PM 8931/00 20 MΩ, 100:1 Passive Probe	125
Active Probes	
PM 8940/09Q High voltage Isolation Amplifier	850
PM 8943Q 650 MHz FET Probe	850
PM 9355/09Q AC Current Probe	1000
Other Accessories	
PM 8901Q Rechargeable Battery Pack	1275
PM 8905 12 Vdc Power Converter	250
PM 8917/003 Video Sync Separator and Line Selector	550
PM 8963/03 Rackmount Adapter	175
PM 8972 Camera adapter for stationary use	85
PM 8991/04 Oscilloscope Cart	450
PM 9051 BNC to 4 mm Banana Adapter	9
PM 9381 Oscilloscope Camera	650
PM 9366 Collapsible Viewing Hood	20

Service & Support

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

Accessories

Compatibility Chart Use this chart to see which oscilloscope accessories are compatible with the Philips oscilloscopes models listed on the right.		PM 3308	PM 3340	PM 3295/96A	PM 3285/86A	PM 3264	PM 3050/55/65/70	PM 3052/57/67/72	PM 3266	PM 3219	PM 3305	PM 3320A	PM 3350/65	PM 3335
Passive Probes														
PM 8911/08	low-impedance wide bandwidth probes		•											
PM 8911/09				•	•							•		
PM 8912/08			•											
PM 8912/09				•	•							•		
PM 8922	switchable x1 and x10 probe									•	•			
PM 8922/501	switchable x1 and x10 probe					•	•	•	•	•	•		•	•
PM 8924/00	x1 probes, modular	•		•	•	•	•	•	•	•	•	•	•	•
PM 8924/20		•		•	•	•	•	•	•	•	•	•	•	•
PM 8926	general purpose x10 probes, modular									•	•			
PM 8926/09							•	•					•	•
PM 8926/20									•	•	•			
PM 8926/29		•					•	•					•	•
PM 8928/00						•			•					
PM 8926/501	general purpose x10 probes					•	•	•	•	•	•		•	•
PM 8926/591							•	•					•	•
PM 8929/09	wide bandwidth probes, modular			•	•							•		
PM 8929/19				•								•		
PM 8929/29				•	•							•		
PM 8931/00	high impedance x100 probes					•			•	•	•			
PM 8931/09				•	•		•	•				•	•	•
PM 8933/101	x10 probe	•												
PM 8936/09	set of 2 probes PM 8926/09						•	•					•	•
Active Probes														
PM 8940/09Q	isolation amplifier	•		•	•	•	•	•	•	•	•	•	•	•
PM 8943Q	FET probe	•	•	•	•	•	•	•	•	•	•	•	•	•
PM 9355/09Q	current probe	•	•	•	•	•	•	•	•	•	•	•	•	•
PM 8917/003	Video line selector	•		•	•	•	•	•	•	•	•	•	•	•
Battery Pack														
PM 8901Q						•	•	•	•	•	•		•	•
DC Converter														
PM 8905										•	•			
Accessory Pouches														
PM 8992/xx			/80	/80	/80	/66	/80		/66	/19	/19	/80	/65	/65
Viewing Hoods														
PM 8980	long type					•			•	•	•			
PM 9311/00				•	•									
PM 9310/00	collapsible			•	•									
PM 8981														
PM 9366						•			•	•	•			
Rackmounts														
PM 8960/03						•			•					
PM 8963/03											•			
PM 8964												•		
PM 8965/03										•				
PM 8964/40			•											
PM 8966														
PM 8969							•						•	•
Cart														
PM 8991/04			•	•	•	•	•		•	•	•	•	•	•
Stand														
PM 8999				•	•	•	•	•	•	•		•	•	•

Accessories

		PM 3308	PM 3340	PM 3295/96A	PM 3285/86A	PM 3264	PM 3050/55/65/70	PM 3052/57/67/72	PM 3266	PM 3219	PM 3305	PM 3320A	PM 3350/65	PM 3335
Camera/Adapters														
PM 9381	Camera kit			●	●	●	●	●	●	●	●		●	●
PM 8972	Camera bezel adapter									●	●			
PM 8976	Camera bezel adapter					●			●					
PM 8977/00	Camera bezel adapter			●	●									
Polaroid Anti-Glare Filter														
PM 8910						●			●	●	●			
Adapters/Terminations														
PM 9051		●		●	●	●	●	●	●	●	●	●	●	●
PM 9053				●	●	●	●	●	●	●	●	●	●	●
PM 9061				●	●	●	●	●	●	●	●	●	●	●
PM 9063/001			●											
PM 9067				●	●	●	●	●	●	●	●	●	●	●
PM 9075				●	●	●	●	●	●	●	●	●	●	●
PM 9581/01				●	●	●	●	●	●	●	●	●	●	●
PM 9585/01				●	●	●	●	●	●	●	●	●	●	●
PM 9599/09	Attenuator				●	●						●		
Coaxial Cables														
PM 9071		●	●	●	●	●	●	●	●	●	●	●	●	●
PM 9074		●	●	●	●	●	●	●	●	●	●	●	●	●
IEEE Cables/Adapters/Interfaces														
PM 2295/05	IEEE-488 cable	●	●	●	●		●	●			●		●	●
PM 2295/10	IEEE-488 cable	●	●	●	●		●	●			●		●	●
PM 2295/20	IEEE-488 cable	●	●	●	●		●	●			●		●	●
PM 2296/50	Adapter			●	●		●	●			●		●	●
PM 2296/60	Adapter													
PM 8956/001	IEEE interface													
PM 8956A/001	IEEE/RS 232 interface											●		
PM 8957	IEEE interface												●	
PM 8958	RS-232 interface												●	
PM 8959/001	IEEEInterface/RS-232 Interface													●
PM 8953A/00	IEEE Interface						●	●						
PM 8950/951	IEEE Interface			●	●									
PM 2101/013	Four-way 50Ω coaxial switch		●	●	●							●		
PM 2195/09	High impedance x10 probe switch			●	●		●	●				●	●	●
Miscellaneous														
PM 8994	Accessory set													
PM 8995	wrap adapters (10 p.c.)													
PM 8988	Front cover						●						●	●
PM 8998	Memory back-up						●	●						

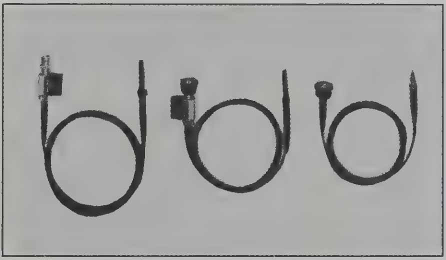
**Oscilloscope model no longer available*

Passive Probe Specifications

Type No.	Attenuation	Useful BW(MHz)	Impedance Ω/pF	Max. Input Voltage (DC + AC PK)	Compensating Range (pF)	Cable Length (M)	Auto Range Indication
PM 8911/08	10x	2000	500//1	15	—	1.5	•
PM 8911/09	10x	1500	500//1	15	—	1.5	•
PM 8912/08	100x	2000	5k//1	50	—	1.5	•
PM 8912/09	100x	1500	5k//1	50	—	1.5	•
PM 8922	1x 10x	10[3] 50	1M//50[1] 10M//15	[2] 600	— 10-60	1.2	
PM 8922/50	1x 10x	6 100	1M//130 10M//14	100 500	— 15-35	1.2	
PM 8924/00	1x	15[3]	1M//47[1]	42	—	1.5	
PM 8924/20	1x	12	1M//74[1]	42	—	2.5	
PM 8926	10x	100	10M//13.5	500	5-40	1.5	
PM 8926/09	10x	100	10M//13.5	500	5-40	1.5	•
PM 8926/20	10x	75	10M//16.5	500	5-40	2.5	
PM 8926/29	10x	75	10M//16.5	500	5-40	2.5	•
PM 8926/50	10x	100	10M//14	500	15-35	1.2	
PM 8926/59	10x	100	10M//14	500	15-35	1.2	•
PM 8928/00	10x	100	10M//13.5	500	5-40	1.5	
PM 8929/09	10x	300	10M//13.5	500	5-20	1.5	•
PM 8929/19	10x	400	10M//12	500	5-20	1	•
PM 8929/29	10x	250	10M//16.5	500	5-20	2.5	•
PM 8931/00	100x	300	20M//2.4	4000	5-30	1.5	
PM 8931/09	100x	300	20M//2.4	4000	5-30	1.5	•
PM 8933/00	10x	50	10M//16.5	500	27-67	1.5	
PM 8933/10	10x	100	1M//35	500	5-40	1.5	•
PM 8936/09 (2x PM 8926/09)	10x	100	10M//13.5	500	5-40	1.5	•

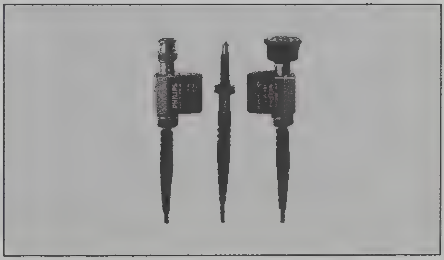
1) Plus input capacity of oscilloscope
2) See maximum input voltage of oscilloscope applied
3) Probe only bandwidth
4) Only with test clip and ground lead

Probe coding for cable length and range indication:
PM 89../XY
Y = 0 no range indication
Y = 9 range indication
X = 0 cable length 1.5m (5 ft)
X = 1 cable length 1m (3.3 ft)
X = 2 cable length 2.5m (8.3 ft)
X = 5 cable length 1.2m (4 ft)
Note: PM 8922 cable length 1.2m (4 ft)



PM 8911/09	$125
PM 8912/09	$125

Wide bandwidth probes for 50Ω inputs

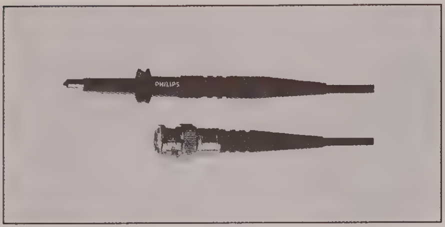


PM 8926	$70
PM 8926/09	$80
PM 8926/20	$70
PM 8926/29	$80
PM 8928/00	$80
PM 8929/09	$90
PM 8929/19	$90
PM 8929/29	$90

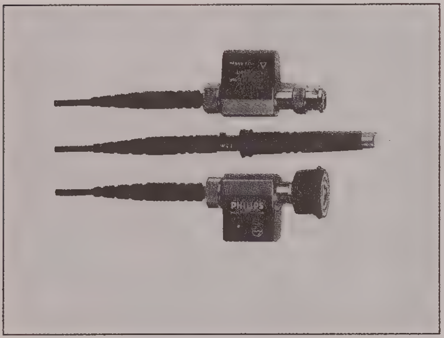
General purpose 1:10 probes for frequencies ranging up to 50...400 MHz, depending on type number.

Note: PM 8936/09 is a set of 2 x PM 8926/09.

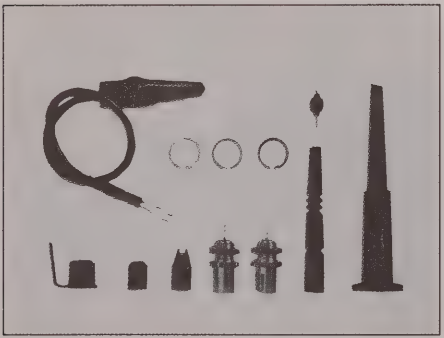
Accessories



PM 8924/00 $60
PM 8924/20 $60
General purpose 1:1 probe

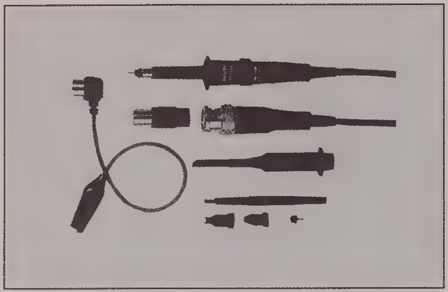


PM 8931/00 $125
PM 8931/09 $135
General purpose 1:100 probes

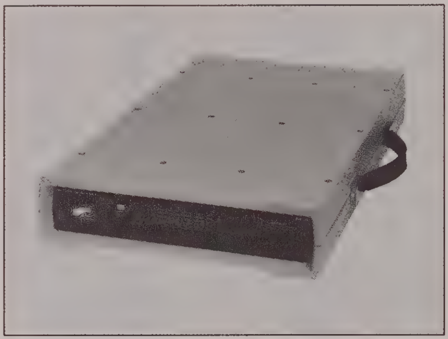


Set of Accessories Supplied with General Purpose Probes

1. Ground lead
2. Mini connector
3. Indication rings
4. Insulating cap
5. Wrap pin adapter
6. Spring loaded test clip
7. Ground needle
8. Measuring tip

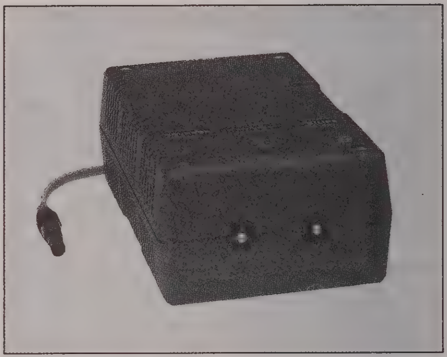


PM 8922 $50
Switchable 1:1, 1:10 probe



PM 8901Q: Battery Pack $1275

Sealed lead-acid batteries provide nominal output voltages of 330 VDC and 24 VDC.
Total Capacity: 180 Wh
Charging Time: 10 hours protected against overload, short circuit and excessive discharge rate.
Dimensions: 32.7 cm W x 7.8 cm H x 50 cm L (12.8 in W x 3 in H x 19.7 in L)
Weight: 9.54 kg (21 lbs) with batteries included.

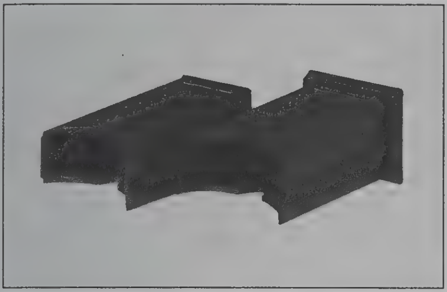


PM 8905: DC-DC Converter $250

12 Vdc to 24 Vdc converter for oscilloscopes with power consumption up to 50W and provided with 24 Vdc power input.
Dimensions: 9.4 cm W x 5.4 cm H x 16.6 cm L (3.7 in W x 2.1 in H x 6.5 in L)
Weight: 0.5 kg (1.1 lbs)

PM 8992: Accessory Pouches $45

PM 8992/19 for PM 3219 and PM 3305
PM 8992/66 for PM 3264 and PM 3266
PM 8992//80 for PM 3050/55, PM 3065/70, PM 3285A/86A, PM 3295A/96A, PM 3320, PM 3340
PM 8992/65 for PM 3335/50/65



PM 8980: Viewing Hood $65
PM 9311/00: Viewing Hood $85

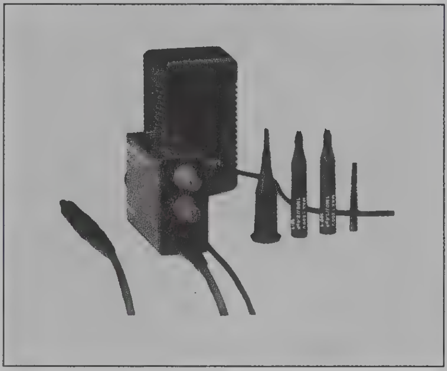
Shielding off of ambient light for better readability of low intensity displays.
PM 8980 for PM 3264, PM 3266, PM 3219, PM 3305
PM 9311/00 for PM 3285A/86A, PM 3295A/96A

PM 8917/003 Video Line Selector $550

Provides trigger pulses to display video waveforms on oscilloscopes

Technical Specifications

System: Accepts both CCIR/EBU (625 line system) and CCIR/FCC (525 line system)
Video Input: 0.5V...3V composite video
Input Impedance: 1 MΩ//30 pF; 75Ω if feed though input is terminated in 75Ω
Max. Non-Destructive Input Voltage: 50V
Output Functions: Frame trigger; field trigger; line trigger; selected line trigger
Output Voltage: 1V in 75Ω
Pulse Width:
Frame Pulse; 0.5x frame width
Field Pulse; 1 µs
Line Pulse; 1 µs
Selected Line Pulse; 64 µs
Powerline Voltage: 90...264V
Powerline Frequency: 44...440 Hz
Power Consumption: 5 VA max.



PM 8943Q FET-Probe $850

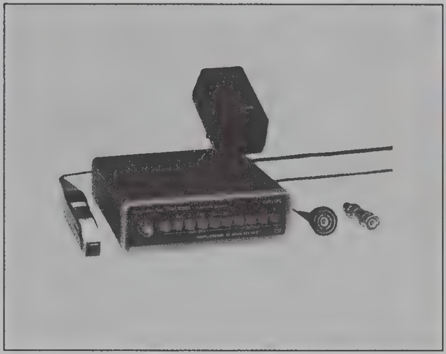
For measurement of low level high frequency signals. The PM 8943 has a very wide frequency response of 650 MHz. An extremely low input capacitance presents minimum loading of the circuit under test. The very wide dynamic range is not limited by the use of any input offset voltage.

Technical Specifications

Frequency Response: DC...650 MHz (-3 dB) (probe output terminated in 50Ω)
Input Attenuators: x1, x10, x100

	x1	x10	x100
Dynamic Range:	+0.6V	+6V	+60V
Input Resistance:	1 MΩ	1 MΩ	1 MΩ
Input Capacitance:	3.5 pF	2.4 pF	1.4 pF
DC Offset Range:	±5V	±50V	±500V

Powerline Voltage: 115V or 220V (-10%...+20%)
Powerline Frequency: 50 Hz...400 Hz (±10%)
Powerline Consumption: 10 VA max.

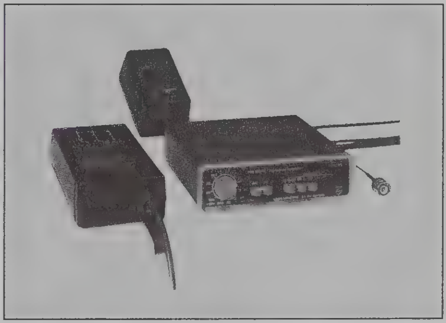


PM 9355/09Q Current Probe $1000

Probe and amplifier combination for displaying and measuring currents in the frequency range of 12 Hz...70 MHz.

Technical Specifications

Deflection Coefficient: 1 mA/div....1 A/div. (oscilloscope set at 20 mV/div.)
Frequency Response:
12 Hz...70 MHz (-3db) at 5 mA/div....1 A/div.; 12 Hz...45 MHz (-3db) at 1 mV/div. and 2 mV/div.
Output Range: +6 or - 6 div. (for f ≥300 Hz)
Powerline Voltage: 115 or 220V (-10%, + 20%)
Powerline Frequency: 50 Hz...400 Hz (±10%)
Powerline Consumption: 10 VA max.



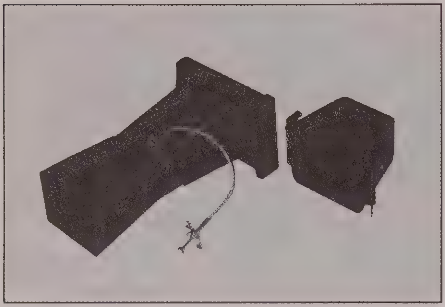
PM 8940/09Q Isolation Amplifier $850

For accurate and safe measurements of small signals floating on high potentials and high frequencies.

Technical Specifications

Frequency Response: DC...1.5 MHz (-3 dB)
Input HI x 10: Max. wire diameter 2 mm
Max. Diff. Input Voltage: 650 Vrms
Diff. Input Impedance: 10 MΩ/9 pF
CMRR: 0.5 div. at CM input voltage of 650 Vrms
Output Dynamic Range: 20 div. at oscilloscope setting of 20 mV/div.
Powerline Voltage: 115V or 220V (-10%...+20%)
Powerline Frequency: 50 Hz...400 Hz (±10%)
Powerline Consumption: 10 VA max.

Accessories



PM 9381

Polaroid camera for instant oscillograms, usable in hand-held or fixed modes. Kit includes camera, hood and spacer body. Specific oscilloscope adapter required for fixed fitting (see diagram/table).

PM 8991/04

Oscilloscope cart allowing the instrument to be positioned from 15° down to 70° up.
Suitable for all Philips oscilloscopes.

PM 8999

Oscilloscope stand for benchtop or floor standing use, adjustable angle.

PM 2195/09 Probe Switch Unit

The PM 2195/09 Probe Switch is a solution to the problems which can occur when switching waveforms in typical GPIB systems. It consists of a 4-input selector switch and 4 attenuator probes. Each probe can be individually adjusted, to ensure a bandwidth of 400 MHz (3 dB) with an oscilloscope and input capacitance of less than 10 pF. The probe switch compact enough to be plugged directly to the input of an oscilloscope. A maximum of 4 probe switches by a PM 2125 probe switch driver, via the GPIB. For more information see page 383.

PM 2260/001 Oscilloscope Signal Processing Software

PM 2260 Oscilloscope signal processing software is a package for the PC, consisting of software drivers to transfer data from Philips DSOs to the PC, and the ASYSTANT™ software package for waveform analysis, display and storage functions. Processing functions include FFT power spectrum, inverse FFT, differentiation, integration, Blackman window, curve fitting, cross correlation and many more. The entire package is menu-oriented and requires no programming skill. See page 377.

Oscilloscope	Hand-held	Fixed mounting
PM 3050/55/65/70, PM 3335/50/65	8x10 camera, HM/PM 9381	Not possible
PM 3219, PM 3305	8x10 camera, HM/PM 9381	Plus adapter PM 8972
PM 3285A/86A, PM 3295A/96A	8x10 camera, HM/PM 9381	Plus adapter PM 8977/00
PM 3264/66	8x10 camera, HM/PM 9381	Plus adapter PM 8976

1 Camera, **2** Hood, **3** Spacer body, **4** Adapter, **PM 9381** = Camera + hood + spacer body
HM 9381 = Camera only (1); **HM 9382** = Spacer body only (3); **HM 9383** = Hood only (2)

Rackmount Kits

Oscilloscope	Rackmount	Height			Length		Width		Price
		E	mm	in	mm	in	mm	in	
PM 3050/55/65/70	PM 8969	3E	133.35	5.25	392	15.43	482.6	19	$225
PM 3219	PM 8965/03	4E	177.8	7	475	18.70	482.6	19	$175
PM 3264	PM 8960/03	4E	177.8	7	543	21.38	482.6	19	$250
PM 3266	PM 8960/03	4E	177.8	7	543	21.38	482.6	19	$250
PM 3305	PM 8963/03	4E	177.8	7	425	16.73	482.6	19	$175
PM 3320A	PM 8964	4E	177.8	7	variable		482.6	19	$650
PM 3340	PM 8964/401	4E	177.8	7	variable		482.6	19	$650
PM 3335/50/65	PM 8969	3E	133.35	5.25	392	15.43	482.6	19	$225

PM 2240/001 TestTeam $925
PM 2230 Series Instrument Driver Software 590

PM 2240 TestTeam offers a complete, multiple window programming and debugging environment for GPIB application programs. It is easy to use, as the programmer is guided through the package with pull-down windows, pop-up screens and a context sensitive help facility. TestTeam contains instrument, graphics and optional analysis libraries, so programming of GPIB instruments and graphical presentation of data is as easy as filling in a screen panel on the PC.
The debugging facilities of TestTeam include syntax checking, breakpoints, single-step execution and variable tracing and programs can be written in QuickBASIC or C. See page 374.
The PM 2230 Series is a library of are libraries of instrument drivers for most Philips/Fluke GPIB instruments, which make programming of these instruments as simple as setting the instrument via the front panel. All drivers include extensive error checking procedures to guarantee the reliability of test results. Drivers are available in BASICA/GWBASIC, Microsoft Pascal, Microsoft C and QuickBASIC.

PM 8155 Digital Pen Plotter $1750

The PM 8155 full DIN A3 plotter can be linked to any DSO in this catalog to give hard copies. With eight pen colors, individual traces are easily identified. Its large 11 x 17 in./297 x 420 mm chart area can be used for multiple plots. Alternatively, the automatic sheet feeder option can be used for many smaller individual plots. With a 32 kbyte internal buffer data transfer occurs at full speed before plotting is complete. This prevents the oscilloscope from being restricted by the plot speed as with smaller buffers.

Technical Specifications

Interface Type: RS-232 or IEEE-488
Graphics Language: HPGL and Philips GL
Plotting Area: Max. 11.7 x 16.1 in./297 x 410 mm (ANSI-B or ISO A3)
Sheet Feeder: Optional for ANSI-A or ISO A4 sizes for full specs, see page 465.

Bench/System Multimeters

This category of digital multimeters (DMMs) features all the Fluke and Philips bench and system meter line. Included are high speed instruments for use in automated test and measurement systems, and more compact, inexpensive models for less demanding jobs on the workbench or, with battery or battery pack, in the field.

Fluke and Philips bench/system multimeters are available with 3-1/2- to 7-1/2-digits of resolution and a variety of accuracy levels. All system meters are available with either GPIB/IEEE-488 or RS-232 interfaces which allow easy system integration.

See the selection guide on the following page for a comparison of basic specifications and features.

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Page 72 8506A

Page 85 Fluke 37

Page 95 8920A

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Selection 60

Bench/System Multimeters 61

Bench/Portable Multimeters 85

RCL Meter 93

RF Voltmeters 95

Bench/System Multimeters

Selection Guide

	Basic Features			Special Features								Interfaces			DC Volts			AC Volts				AC/DC Amp		Ohms, Etc.				
Models	Max Number of Digits	Display	Autoranging	Burst Memory	dB, dBm Readout	Offset/Relative Ref	Touch-Hold	Counter Timer	Capacitance	Temperature	IEEE-488	RS-232-C	Parallel/BCD	Basic 90 Day Accuracy, %	Max Resolution, µV	Max Voltage, w/o Probe	True-RMS	Basic 90 Day Accuracy, %	Max Resolution, µV	Frequency Range, Hz	Max Resolution, nA	Max Amps, w/o Probe	Max Resolution, mΩ*	Max Resistance, MΩ	Diode Test	Conductance (Low) >20 MΩ	**Pg**
Bench/System Multimeters																											
8840A	5-1/2	VF*	(1)	–	–	•	–	–	–	–	Δ	–	–	0.004	1.0	1000	Δ	0.14	1.0	100k	10k	2.0	1.0	20	–	–	61
8842A	5-1/2	VF*	(1)	–	–	•	–	–	–	–	Δ	–	–	0.0025	0.1	1000	Δ	0.07	1.0	100k	1k	2.0	0.1	20	–	–	61
8840A/AF	5-1/2	VF*	(1)	–	–	•	–	–	–	–	Δ	–	–	0.004	1.0	1000	Δ	0.14	1.0	100k	10k	2.0	1.0	20	–	–	61
PM 2525	5-1/2	LCD	(1)	–	•	•	Δ	•	•	(5)	Δ	Δ	Δ	0.02	1.0	1000	•	0.3	10	100k	0.1	100	10	100	–	–	67
8505A	7-1/2	LED	(1)	–	–	•	–	–	–	–	Δ	Δ	Δ	0.001	0.1	1200	Δ	0.1	1.0	1M	0.1	1.28	0.01	265	–	–	72
8506A	7-1/2	LED	(1)	–	–	•	–	–	–	–	Δ	Δ	Δ	0.001	0.1	1200	•	0.016	1.0	1M	0.1	1.28	0.01	265	–	–	72
8502A	6-1/2	LED	(1)	–	–	•	–	–	–	–	Δ	Δ	Δ	0.001	1.0	1280	Δ	0.1	1.0	1M	1.0	1.28	0.1	262	–	–	99
8520A	5-1/2	LED	(1)	•	Δ	•	–	–	–	–	•	–	–	0.005	1.0	1000	•	0.1	10	1M	–	(3)	0.1	20	–	•	77
8522A	5-1/2	LED	(1)	•	•	•	–	–	–	–	–	–	•	0.005	1.0	1000	•	0.1	10	1M	–	(3)	0.1	20	–	•	77
PM 2534	6-1/2	LCD	(1)	•	–	–	Δ	–	–	–	•	–	–	0.0025	0.1	600	(6)	0.2	10	100k	100	(3)	0.1	300	–	–	81
PM 2535	6-1/2	LCD	(1)	•	•	–	Δ	–	–	–	•	–	–	0.0025	0.1	600	(6)	0.2	10	100k	100	(3)	0.1	300	–	–	81
Bench/Portable Multimeters																											
Fluke 37	3-1/2	LCD	(1)	–	–	•	•	–	–	–	–	–	–	0.1**	100	1000	–	0.5	100	30k	100	10.0	100	32	•	•	85
8050A	4-1/2	LCD	–	–	•	•	(4)	–	–	–	–	–	–	0.03**	10	1000	•	0.5	10	50k	10	2.0	10	20	•	•	87
8010A	3-1/2	LCD	–	–	–	–	(4)	–	–	–	–	–	–	0.1**	100	1000	•	0.5	100	50k	100	10	100	20	•	•	90
8012A	3-1/2	LCD	–	–	–	–	(4)	–	–	–	–	–	–	0.1**	100	1000	•	0.5	100	50k	100	2.0	1.0	20	•	•	90
Wideband True-RMS AC Digital Voltmeters																											
8920A	3-1/2	LED	(1)	–	•	•	–	–	–	–	Δ	–	Δ	(2)	(2)	(2)	•	0.5	1.0	20M	–	(3)	–	–	–	–	95
8921A	3-1/2	LED	(1)	–	•	•	–	–	–	–	Δ	–	Δ	(2)	(2)	(2)	•	0.5	1.0	20M	–	(3)	–	–	–	–	95
8922A	3-1/2	LED	(1)	–	•	•	–	–	–	–	Δ	–	Δ	(2)	(2)	(2)	•	0.5	1.0	20M	–	(3)	–	–	–	–	95
Wideband AC Millivoltmeter																											
PM 2554		Analog	–	–	•	–	–	–	–	–	–	–	–	–	–	–	•	1.5	10	12M	–	–	–	–	–	–	98
Automatic RCL Meter																											
PM 6303	4	LCD	•	–	–	–	–	–	(7)	–	–	–	–	–	–	–	–	–	–	–	–	–	1.0	200	•	•	93

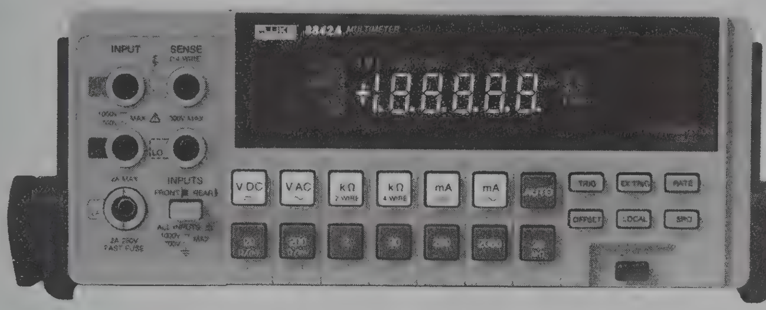
(1) Or Manual ranging
(2) Will measure dc in ac-dc mode
(3) Use 80J-10 or A90 Shunt for up to 10A
(4) Use 80T-H Probe
(5) With PT 100 Probe
(6) AC-coupled RMS
(7) Nine measurement parameters: (D, Q, Rp, Rs, Z, Ls or Lp, Cs or Cp and Cs 2V bias)

• Standard
Δ Optional
** Vacuum fluorescent*
*** 1-year accuracy*

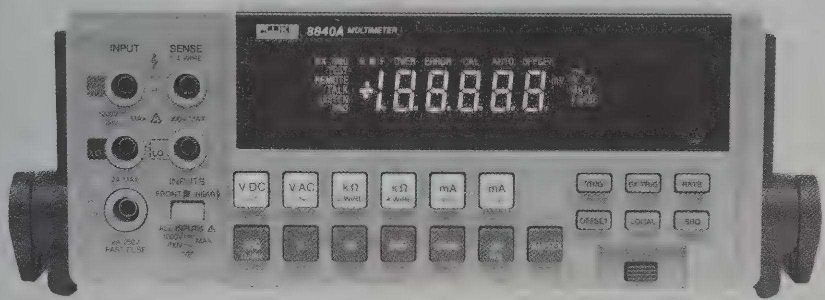
For Handheld Multimeters see page 101.
For Multimeter Accessories see page 127.

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

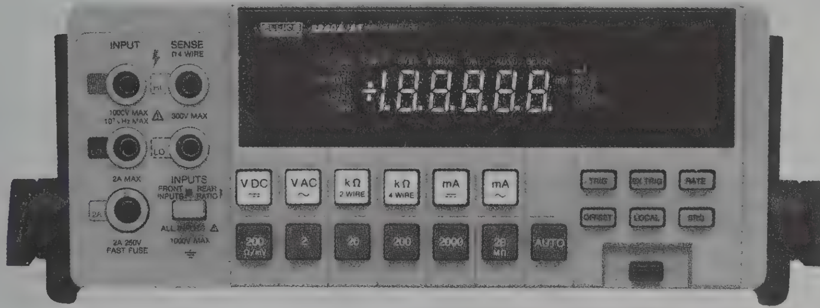
8840 Series



8842A



(NSN 6625--01-217-9427) **8840A**



(NSN 6625-01-196-0014) **8840A/AF**

8840 Series: 5-1/2 Digit Multimeters

- Basic 1-year dc accuracies to 0.003%; ohms accuracy to 0.008%
- Ohms and dc current standard • Ac voltage and current optional (8842A, 8840A)
- Full system capability with optional GPIB/IEEE-488 interface
- Up to 100 readings/second system speed
- Vacuum fluorescent display
- Closed-case calibration • Comprehensive self test

Performance

The 8840 Series has performance you would expect in multimeters costing much more. Basic dc accuracies to 0.003% and basic ac accuracies to 0.08% at one year are available. See the specifications that follow for complete information on measurement ranges and accuracy.

Closed-Case Calibration

No internal adjustments are required for calibration. After you initiate calibration via a recessed front panel switch, you are led through a software controlled procedure that even double checks to ensure that appropriate reference inputs have been applied. Calibration can be performed under front panel or GPIB/IEEE-488* control.

Self Testing

The 8840 Series automatically performs a digital self test each time it is powered up. Additionally, you can initiate a comprehensive analog and digital diagnostic self test from the front panel or through the IEEE-488 interface.

Powerful System Capabilities

Adding the inexpensive IEEE-488 interface option to the 8840 Series provides system capability which includes complete system control of functions, ranges, and reading rates. Front and rear panel inputs are switch-selectable from the front panel (and you can sense the status of the switch over the bus). Calibration and self-test can also be controlled over the bus.

Powerful yet simple device dependent IEEE-488 code allows the 8840 Series DMMs to be easily integrated into your system. System software written for the 8840A is compatible with the 8842A and 8840A/AF.

The mechanical design also contributes to performance and convenience in system applications. The 8840A Series' metal case provides EMI shielding to ensure measurement integrity. The unit can be mounted in a half-rack slot simply by removing the handle, turning the "twist-away" rear feet, and bolting on rackmount brackets.

Embodying all these features, the 8840 Series DMMs are fully programmable, powerful digital multimeters within reach of every system builder.

Technology

A monolithic A/D converter uses CMOS IC designed to achieve the superb accuracy, speed, and reliability of the 8840 Series.

Analog switch ICs developed by Fluke replace discrete switching devices to create superior performance, reliability, and serviceability.

A voltage reference device similar to that found in the Fluke 732A DC Reference Standard provides unmatched stability.

Precision thin film resistor networks establish the accuracy and maintain the stability of the 8840 Series.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

8842A

Now You Can Choose The 8840 Series DMM To Meet Your Performance Needs

8842A: Premium Performance

The 8842A, top of the 8840 line, delivers all the features of the popular 8840A plus new hermetically sealed thin film resistors. These resistors make possible:

- **Increased measurement power:**
  100 nV resolution with a 20 mV range
  1 µA °C resolution with 200 mA range
  100 µΩ resolution with a 20Ω range
- **Enhanced accuracy in V dc, V ac, Ω**
  0.003% basic dc accuracy at 1 year
  0.08% basic ac accuracy at 1 year
  0.006% basic Ω accuracy at 1 year
- **Extended cal cycles, with 2 year specifications**
  0.005% basic dc accuracy at 2 years
- **Two year warranty**

8840A: The Original Value Leader

The original 8840A continues to provide an outstanding combination of low price and high performance. These features, common to all members of the 8840 Series, are responsible for the popularity of the 8840A.

- 0.005% basic dc accuracy at 1 year
- Ease of IEEE-488 system integration
- Closed case calibration
- Extensive self test
- High reliability
- Vacuum fluorescent display
- Fluke's one year warranty applies

8840A/AF: For Tough Assignments

The 8840A/AF delivers all of the 8840A capabilities plus:

- Expanded environmental envelope
- Compliance with MIL-T-28800C Type II, Class 3, Style B
- True rms ac voltage/current capability is standard
- 1000V rms ac maximum allowable input
- Enhanced EMI/RFI protection
- Fluke's one year warranty applies

8842A Specifications

Technical Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5- 1/2 Digits	Resolution 4-1/2* Digits	Input Resistance
20 mV	19.9999 mV	0.1 µV	1 µV	≥10,000 MΩ
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.9999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts)

Range	24 Hour [1] 23±1°C	90 Day 23±5°C	1 Year 23±5°C	2 Year 23±5°C
20 mV [2]	0.0050+20	0.0070+30	0.0100+30	0.0120+40
200 mV [2]	0.0030+2	0.0045+3	0.0070+3	0.0100+4
2V	0.0015+2	0.0025+2	0.0030+2	0.0050+3
20V	0.0015+2	0.0030+2	0.0035+2	0.0060+3
200V	0.0015+2	0.0030+2	0.0035+2	0.0060+3
1000V	0.0020+2	0.0035+2	0.0045+2	0.0070+3

[1] *Relative to calibration standards*
[2] *Within one hour of dc zero, using offset control.*

Medium and Fast Rates: In medium rate, add 2 counts (20 counts on 20 mV range) to number of counts. In fast rate, use two 4-1/2 digit counts (20 counts on 20 mV range) for the number of counts

Operating Characteristics

Temperature Coefficient: >±(0.0006% of Reading + 0.3 Count) per °C fron 18°C to 0°C and 28°C to 50°C

Maximum Input: 1000V dc or peak ac on any range

Noise Rejection: Automatically optimized at power-up for 50, 60 or 400 Hz

Rate	Readings/ Second [1]	Filter	NMRR [2]	Peak NM Signal	CMRR [3]
S	2.5 [5]	Analog & Digital	>98 dB	20V or 2xFS [4]	>140 dB
M	20 [6]	Digital	>45 dB	1xFS	>100 dB
F	100	None	–	1xFS	>60 dB

[1] *Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.*
[2] *Normal Mode Rejection Ratio, at 50 or 60 Hz ± 0.1%. The NMRR for 400 Hz ± 0.1% is 85 dB in S rate and 35 dB in M rate.*
[3] *Common Mode Rejection Ratio at 50 or 60 Hz ± 0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.*
[4] *20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V.*
[5] *Reading rate – .31 rdg/sec. in the 20 mV, 20Ω, 200 mA dc ranges.*
[6] *Reading rate – 1.25 rdg/sec. in the 20mV, 20Ω, 200 mA dc ranges*

True-RMS AC Voltage Option (-09)

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2 Digits	Input Resistance
200mV	199.999 mV	1 µV	10 µV	1 MΩ
2V	1.99999V	10 µV	100 µV	shunted
20V	19.9999V	100 µV	1 mV	by
200V	199.999V	1 mV	10 mV	>100 pF
700V	700.00V	10 mV	100 mV	

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sineware inputs ≥10,000 counts[1] (5% of range)

Freq (Hz)	24 Hour2 23 ±°C	90 Day 23 ±5°C	1 Year 23 ±5°C	2 Year 23 ±5°C
20-45	1.2+100	1.2+100	1.2+100	1.2+100
45-200	0.3+100	0.35+100	0.4+100	0.5+100
200-20k				
(200 mV)	0.06+100	0.08+100	0.10+100	0.20+100
(2-200V)	0.05+80	0.07+80	0.80+80	0.15+80
(700V)	0.06+100	0.08+100	0.10+100	0.20+100
20-50k	0.15+120	0.19+150	0.21+200	0.25+250

[1] *For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz t, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz.*
[2] *Relative to calibration standard.*

Medium and Fast Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥ 1000 4-1/2 digit counts and >100 Hz

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications.

Fundamental Frequency	Crest Factor 1.0 to 1.5	Crest Factor 1.5 to 2.0	Crest Factor 2.0 to 3.0
45 Hz to 20 kHz	0.05	0.15	0.3
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2	0.7	1.5

Operating Characteristics

Maximum Input: 700V rms, 1000V peak or 2 x 10^7 Volts-Hertz product (whichever is less) for any range

Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz , 20k-20k	Frequency in Hertz , 20k-50k	Frequency in Hertz , 50k-100k
≥10,000 counts	0.019+9	0.021+9	0.027+10
≥1,000 counts	0.019+12	0.021+15	0.027+21

Common Mode Rejction: >60 dB at 50 or 60Hz with 1 kΩ in either lead

8842A

Current

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2 Digit[1]
200 mA[2]	199.999 mA	1 µA	10 µA
2000 mA	1999.99 mA	10 µA	100 µA

[1] *4-1/2 digits at the fastest reading rate*
[2] *200 mA range is dc only*

DC Accuracy
Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Range	90 Days 23 ±5°C	1 Year 23 ±5°C	2 Years 23 ±5°C
200 mA	0.04+40	0.05+40	0.08+40
2000 mA			
≤1A	0.04+4	0.05+4	0.08+4
>1A	0.1+4	0.1+4	0.15+4

Medium and Fast Rates: In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4-1/2 digit counts (20 counts on 200 mA range) for number of counts
AC Accuracy: (Requires Option -09)
Normal (S) Reading Rate: ±(% of Reading + Number of Counts) 23° ± 5°C, for sinewave inputs ≥10,000 counts

Time	Frequency in Hertz 20-45	45-100	100-5k*
One Year	2.0 + 200	0.5 + 200	0.4 + 200
Two Years	3.0 + 300	0.7 + 300	0.6 + 300

* *Typically 20 kHz*

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4-1/2 digit counts and frequencies >100 Hz, the accuracy is ± (0.2 % of reading + 30 counts)
Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	Frequency in Hertz 1.0 to 1.5	1.5 to 2.0	2.0 to 3.0
45 Hz to 5 kHz	0.05	0.15	0.3
20 Hz to 45 Hz	0.2	0.7	1.5

Operating Characteristics
Temperature Coefficient: Less than 0.1 x accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C
Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse
Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2[1] Digits	Current Through Unknown
20Ω[2]	19.9999Ω	0.1 mΩ	1 mΩ	1 mA
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 µA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 µA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 µA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 µA

[1] *4-1/2 digits at the fastest reading rate*
[2] *4-wire ohms only*

Accuracy
Normal (S) Reading Rate: ± (% of Reading + Number of Counts)[1]

Range	24 Hour[2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C	2 Year 23 ±5°C
20Ω[3]	0.007+30	0.009+40	0.012+40	0.015+40
200Ω	0.0040+3	0.007+4	0.010+4	0.012+4
2 kΩ	0.0025+2	0.005+3	0.008+3	0.010+3
20 kΩ	0.0025+2	0.005+3	0.008+3	0.010+3
200 kΩ	0.0025+2	0.006+3	0.010+3	0.012+3
2000 kΩ	0.023+3	0.025+3	0.027+3	0.030+3
20 MΩ	0.023+3	0.040+4	0.042+4	0.050+4

[1] *Within one hour of ohms zero, using offset control*
[2] *Relative to calibration standards*
[3] *4-wire ohms only*

Medium and Fast Reading Rates: In medium rate, add 2 counts to the number of counts for the 200Ω through 200 kΩ ranges, 3 counts for the 2000 kΩ and 20 MΩ ranges, and 20 counts for the 20Ω range. In fast reading rate, use three 4-1/2 digit for the number of counts for the 200Ω range, 20 4-1/2 digit counts for the 20Ω range, and two 4-1/2 digit for all other ranges

Operating Characteristics
Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C
Measurement Configuration: 2-wire or 4-wire (20Ω range is 4-wire only)
Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges
Input Protection: To 300V rms

Reading Rates and Ranging

Reading Rates With Internal Trigger (readings per second):

Rate	Power Line Frequency[1] 50 Hz	60 Hz	400 Hz
S	2.08 (.26[2])	2.5 (.31[2])	2.38 (.30[2])
M	16.7 (1.04[2])	20 (1.25[2])	19.0 (1.19[2])
F	100	100	100

[1] *Sensed automatically at power-up.*
[2] *In the 20 mV, 20Ω, and 200 mA ranges. The 8842A does not autorange down into these ranges. To access these ranges, select the specific range, from the front panel or over the bus*

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, CT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground
Temperature Range: 0°C to 50°C operating; -40°C to 70°C storage
Humidity Range: 80% RH from 0 to 35°C; 70% to 50°C
Warmup Time: 1 hour to rated specifications
Power: 100, 120, 220, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50, 60, or 400 Hz, automatically sensed at power up; 20 VA maximum
Vibration: Meets requirements of MIL-T-288000C for Type III, Class 3, Style E equipment
Safety: ANSI C39.5 and IEC 348, Class I and VDE 0411 Marks License
Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.5 in x 8.5 in x 14.6 in)
Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)
Warranty Period: Two years
Included: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, instrument performance verificaiton record and serialized and dated calibration sheet

Ordering Information

Models

January 1989 prices

Model	Price
8842A* Basic Digital Multimeter (DC only)	$995
8842A/05 w/IEEE-488 Interface	1145
8842A/09 w/AC Measurement Capability	1245
8842A/059 w/IEEE-488 I/F and AC Measurements	1395

**Option /09 or /059 needed to measure ac*

Options (for 8842A)

Option	Price
-05K* IEEE-488 Interface Kit	170
-09K* True-RMS AC Kit	270

**Required recalibration*

Accessories (Also see page 127)

Accessory	Price
Y8834 Single Rack Mount Kit Offset	65
Y8835 Dual Rack Mount Kit	100
Y8021 1m IEEE-488 Shielded Cable	130
Y8022 2m IEEE-488 Shielded Cable	145
Y8023 4m IEEE-488 Shielded Cable	155
Y8077 Four Terminal Short	35
A90 6-Range Current Shunt	700

8840A

8840A Specifications

Technical Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2* Digits	Input Resistance
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.9999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts)

Range	24 Hour [1] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200 mV [2]	0.003+3	0.007+4	0.008+4
2V	0.002+2	0.004+3	0.005+3
20V	0.002+2	0.005+3	0.006+3
200V	0.002+2	0.005+3	0.006+3
1000V	0.003+2	0.005+3	0.007+3

[1] *Relative to calibration standards*

[2] *Using Offset control*

Medium and Fast Rates: In medium rate, add 2 counts. In fast rate, use two 4-1/2 digit counts

Operating Characteristics

Temperature Coefficient: >±(0.0006% of Reading + 0.3 Count) per °C from 18°C to 0°C and 28°C to 50°C

Maximum Input: 1000V dc or peak ac on any range

Noise Rejection: Automatically optimized at power-up for 50, 60 or 400 Hz

Rate	Readings/ Second [1]	Filter	NMRR [2]	Peak NM Signal	CMRR [3]
S	2.5	Analog & Digital	>98 dB	20V or 2xFS [4]	>140 dB
M	20	Digital	>45 dB	1xFS	>100 dB
F	100	None	–	1xFS	>60 dB

[1] *Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.*

[2] *Normal Mode Rejection Ratio, at 50 or 60 Hz ± 0.1%. The NMRR for 400 Hz ± 0.1% is 85 dB in S rate and 35 dB in M rate.*

[3] *Common Mode Rejection Ratio at 50 or 60 Hz ± 0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.*

[4] *20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V.*

True-RMS AC Voltage Option (-09)

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2* Digits	Input Resistance
200 mV	199.999 mV	1 µV	10 µV	1 MΩ shunted by >100 pF
2V	1.99999V	10 µV	100 µV	
20V	19.9999V	100 µV	1 mV	
200V	199.999V	1 mV	10 mV	
700V	700.00V	10 mV	100 mV	

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sinewave inputs ≥10,000 counts [1] (5% of range)

Range	24 Hour [1] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
20-45	1.2+100	1.2+100	1.2+100
45-200	0.3+100	0.35+100	0.4+100
100-20k	0.07+100	0.14+100	0.16+100
20-50k	0.15+120	0.19+150	0.21+200
50-100k	0.4+300	0.5+300	0.5+400

[1] *For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz.*

[2] *Relative to calibration standards*

Medium and Fast Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 4-1/2 digit counts and >100 Hz

Operating Characteristics

Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz 20k-20k	20k-50k	50k-100k
≥10,000 counts	0.019 +9	0.021 +9	0.027 +10
≥1,000 counts	0.019 +12	0.021+15	0.027 +21

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency conponents ≤100 kHz, add the following % of reading to the accuracy specifications.

Fundamental Frequency	1.0 to 1.5*	1.5 to 2.0	2.0 to 3.0
45 Hz to 20 kHz	0.05	0.15	0.3
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2	0.7	1.5

**Crest Factor*

Maximum Input: 700V rms, 1000V peak or 2 x 107 Volts-Hertz product (whichever is less) for any range

Common Mode Rejection: >60 dB at 50 or 60Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2 Digit *
2000 mA	1999.99 mA	10 µA	100 µA

**4-1/2 digits at the fastest reading rate*

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Time	90 Days 23 ±5°C	1 Year 23 ±5°C
≤1A	0.04 +4	0.05 +4
>1A	0.1 +4	0.1 +4

Medium and Fast Rates: In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4-1/2 digit counts (20 counts on 200 mA range) for number of counts

AC Accuracy: (Requires Option -09)

Normal (S) Reading Rate: ±(% of Reading + Number of Counts) 23° ±5°C, for sinewave inputs ≥10,000 counts

Time	Frequency in Hertz 20-45	45-100	100-5k*
One Year	2.0 +200	0.5 +200	0.4 +200

**Typically 20 kHz*

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4-1/2 digit counts and frequencies >100 Hz, the accuracy is ±(0.2% of reading + 30 counts)

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C

Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse

Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution 5-1/2 Digits	Resolution 4-1/2 * Digits	Current Through Unknown
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 µA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 µA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 µA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 µA

**4-1/2 digits at the fastest reading rate*

8840A & 8840A/AF

Accuracy

Normal (S) Reading Rate: ± (% of Reading + Number of Counts)[1]

Range	24 Hour [2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200Ω	0.004+3	0.011+4	0.014+4
2 kΩ	0.0028+2	0.01+3	0.013+3
20 kΩ	0.0028+2	0.01+3	0.013+3
200 kΩ	0.0028+2	0.01+3	0.013+3
2000 kΩ	0.023+3	0.027+3	0.028+3
20 MΩ	0.023+3	0.043+4	0.044+4

[1] *Using Offset control*

[2] *Relative to calibration standards*

Medium and Fast Reading Rates: In medium rate, add to the number of counts 2 counts for the 200Ω through 200 kΩ ranges and 3 counts for the 2000 kΩ and 20 MΩ ranges. In fast reading rate, use for the number of counts three 4-1/2 digit counts for the 200Ω range and two 4-1/2 digit counts

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

Measurement Configuration: 2-wire or 4-wire

Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges

Input Protection: To 300V rms

Reading Rates

Reading Rates With Internal Trigger (readings per second):

Rate	Power Line Frequency*		
	50 Hz	60 Hz	400 Hz
S	2.08	2.5	2.38
M	16.7	20	19.0
F	100	100	100

[1] *Sensed automatically at power-up.*

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground

Temperature Range: 0°C to 50°C operating; -40°C to 70°C storage

Humidity Range: 80% RH from 0 to 35°C; 70% to 50°C

Warmup Time: 1 hour to rated specifications

Power: 100, 120, 220, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50, 60, or 400 Hz, automatically sensed at power up; 20 VA maximum

Vibration: Meets requirements of MIL-T-28800C for Type III, Class 3, Style E equipment

Safety: ANSI C39.5 and IEC 348, Class I and VDE 0411 Marks License

Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.5 in x 8.5 in x 14.6 in)

Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)

Warranty Period: One year

Included: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, instrument performance verification record and serialized/dated calibration certification sheet

Ordering Information

Models

January 1989 prices

8840A* Basic Digital Multimeter (DC only)	$795
8840A/05 w/IEEE-488 Interface	945
8840A/09 w/AC Measurement Capability	990
8840A/059 w/IEEE-488 I/F and AC Measurements	1140

**Option /09 or /059 needed to measure ac*

Options (for 8840A)

-05K* Field Installable IEEE-488 Interface Kit	170
-09K* Field Installable True-RMS AC	205

**Requires recalibration*

Accessories (Also see page 127)

8840A/AF Specifications

Technical Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution		Input Resistance
		5-1/2 Digits	4-1/2* Digits	
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.9999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts)

Range	24 Hour [1] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200 mV [2]	0.003+3	0.007+4	0.008+4
2V	0.002+2	0.004+3	0.005+3
20V	0.002+2	0.005+3	0.006+3
200V	0.002+2	0.005+3	0.006+3
1000V	0.003+2	0.005+3	0.007+3

[1] *Relative to calibration standards*

[2] *Using Offset control*

Medium and Fast Rates: In medium rate, add 2 counts. In fast rate, use two 4-1/2 digit counts

Operating Characteristics

Temperature Coefficient: >±(0.0006% of Reading + 0.3 Count) per °C fron 18°C to 0°C and 28°C to 50°C

Maximum Input: 1000V dc or peak ac on any range

Noise Rejection: Automatically optimized at power-up for 50, 60 or 400 Hz

Rate	Readings/ Second [1]	Filter	NMRR [2]	Peak NM Signal	CMRR [3]
S	2.5	Analog & Digital	>98 dB	20V or 2xFS [4]	>140 dB
M	20	Digital	>45 dB	1xFS	>100 dB
F	100	None	–	1xFS	>60 dB

[1] *Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.*

[2] *Normal Mode Rejection Ratio, at 50 or 60 Hz ± 0.1%. The NMRR for 400 Hz ± 0.1% is 85 dB in S rate and 35 dB in M rate.*

[3] *Common Mode Rejection Ratio at 50 or 60 Hz ± 0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.*

[4] *20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V.*

True-RMS AC Voltage

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution		Input Resistance
		5-1/2 Digits	4-1/2* Digits	
200 mV	199.999 mV	1 µV	10 µV	1 MΩ shunted by >100 pF
2V	1.99999V	10 µV	100 µV	
20V	19.9999V	100 µV	1 mV	
200V	199.999V	1 mV	10 mV	
700V	700.00V	10 mV	100 mV	

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sinewave inputs ≥5% of range (10,000 counts[1])

Range	24 Hour [1] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
20-45	1.2+100	1.2+100	1.2+100
45-100	0.3+100	0.35+100	0.4+100
100-20k	0.07+100	0.14+100	0.16+100
20-50k	0.15+120	0.19+150	0.21+200
50-100k	0.4+300	0.5+300	0.5+400

[1] *For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz.*

[2] *Relative to calibration standards*

Medium and Fast Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 4-1/2 digit counts and >100 Hz

8840A/AF

Operating Characteristics

Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz		
	20k-20k	20k-50k	50k-100k
≥10,000 counts	0.019+9	0.021+9	0.027+10
≥1,000 counits	0.019+12	0.021+15	0.027+21

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications.

Fundamental Frequency	1.0 to 1.5*	1.5 to 2.0	2.0 to 3.0
45 Hz to 20 kHz	0.05	0.15	0.3
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2	0.7	1.5

**Crest Factor*

Maximum Input: 1000V rms or 2 x 10^7 Volts-Hertz product (whichever is less) for any range

Common Mode Rejection: >60 dB at 50 or 60 Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution	
		5-1/2 Digits	4-1/2 Digit *
2000 mA	1999.99 mA	10 µA	100 µA

**4-1/2 digits at the fastest reading rate*

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Current	90 Days 23±5°C	1 Year 23±5°C
≤1A	0.04+4	0.05+4
>1A	0.1+4	0.1+4

Medium and Fast Rates: In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4-1/2 digit counts (20 counts on 200 mA range) for number of counts

AC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts) 23°±5°C, for sinewave inputs ≥10,000 counts

Time	Frequency in Hertz		
	20-45	45-100	100-5k*
One Year	2.0+200	0.5+200	0.4+200

** Typically 20 kHz*

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4-1/2 digit counts and frequencies >100 Hz, the accuracy is ±(0.2% of reading + 30 counts)

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C

Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse

Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution		Current Through Unknown
		5-1/2 Digits	4-1/2 * Digits	
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 µA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 µA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 µA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 µA

**4-1/2 digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rate: ± (% of Reading + Number of Counts)[1]

Range	24 Hour [2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200Ω	0.004+3	0.011+4	0.014+4
2 kΩ	0.0028+2	0.01+3	0.013+3
20 kΩ	0.0028+2	0.01+3	0.013+3
200 kΩ	0.0028+2	0.01+3	0.013+3
2000 kΩ	0.023+3	0.027+3	0.028+3
20 MΩ	0.023+3	0.043+4	0.044+4

[1] Using Offset control
[2] Relative to calibration standards

Medium and Fast Reading Rates: In medium rate, add to the number of counts 2 counts for the 200Ω through 200 kΩ ranges and 3 counts for the 2000 kΩ and 20 MΩ ranges. In fast reading rate, use for the number of counts three 4-1/2 digit counts for the 200Ω range and two 4-1/2 digit counts

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

Measurement Configuration: 2-wire or 4-wire

Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges

Input Protection: To 300V rms

Reading Rates

Reading Rates With Internal Trigger (readings per second):

Rate	Power Line Frequency[1]		
	50 Hz	60 Hz	400 Hz
S	2.08	2.5	2.38
M	16.7	20	19.0
F	100	100	100

[1] Sensed automatically at power-up.

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground

Temperature Range: 0°C to 55°C operating; -62°C to 85°C storage

Humidity Range: 95% RH, +5% to 0%

EMI: Complies with CE01, CE03, CS01, CS02, CS06, and REO2 as specified in MIL-STD-461

Altitude: 4,500m (15,000 ft) operating; 12,000m (40,000 ft) non-operating

Warmup Time: 1 hour to rated specifications

Power: 100, 120, 220, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50, 60, or 400 Hz, automatically sensed at power up; 20 VA maximum

Vibration: Meets requirements of MIL-T-28800C for Type III, Class 3, Style E equipment

Safety: ANSI C39.5 and IEC 348, Class I and VDE 0411 Marks License

Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.47 in x 8.5 in x 14.6 in)

Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)

Warranty Period: One year

Included: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, (with Option -05 only), instrument performance verificaiton record and serialized/dated calibration certification sheet

Ordering Information

Model	January 1989 prices
8840A/AF* Digital Multimeter	$1350

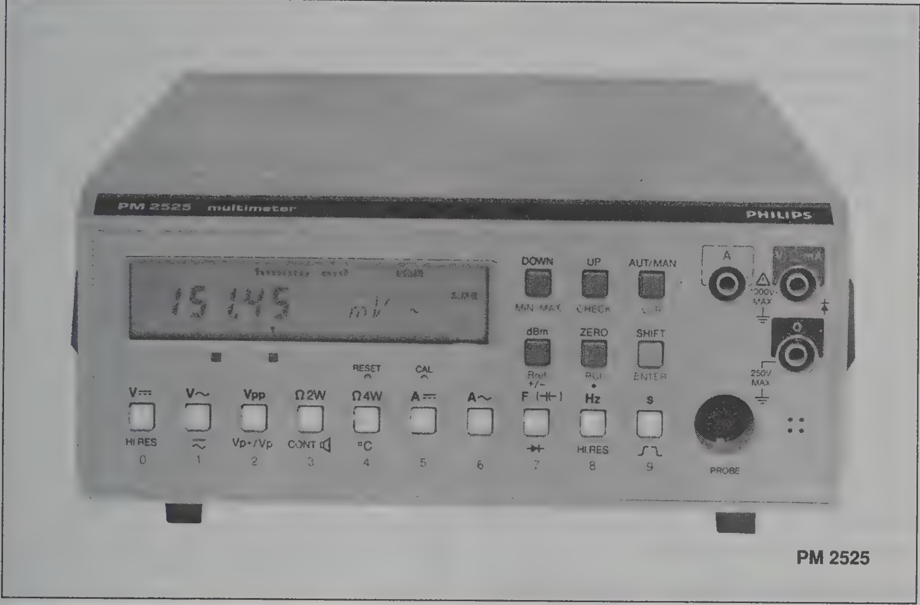
Options (for 8840A/AF)

-05 IEEE-488 Interface	150
-05K Field Installable IEEE-488 Interface Kit	170

PM 2525

GPIB
IEEE-488

RS-232



PM 2525

PM 2525 Digital Multifunctional Multimeter

- 4-1/2 to 5-1/2 digit meter with 0.1 nA resolution (±0.4% ±1.5 digit)
- More measurement functions (Hz, Time, Capacitance, Temp, etc.)
- Battery option for field use
- GPIB/IEEE-488, RS-232C and analog output options for system operation
- Simple command structure for system programming
- Comprehensive overload protection

PM 2525 Measurement Center

The PM 2525 is a very high specification instrument, offering a full range of standard DMM measurement features plus a range of unique extra functions, making it a complete **"measurement center."**

Besides standard functions such as 8 current, 5 voltage and 7 resistance ranges, the PM 2525 also has the additional features of measurement of frequency, time, temperature, capacitance, dB and continuity.

For precision measurements the PM 2525 includes a 21,000 count facility plus a high resolution mode of 210,000 counts. This gives a resolution down to 1μV for Vdc; 100 pA for ac and dc current; 10 mohm for resistance; and 1 pF for capacitance.

Bench, Battery or System Versions

The PM 2525 is available in five versions covering most applications:

1. **Basic benchtop model:** For use in laboratory, workshop and production environments.
2. **Battery model:** For field use. Rechargeable battery for 5 hrs operation included.
3. **Instrument with an analog output:** For analog registration of the results.
4. **GPIB/IEEE-488* interface version:** For operation with IEEE systems.
5. **RS-232 instrument:** For operation with a computer.

The last two interface versions allow remote control of all instrument settings and downloading of measured values to a computer or system controller. These versions are supplied with special interface software which has the same command structure, in plain English, used by Philips system multimeters. Meters with an interface also have an additional high speed mode which provides 3-1/2 digit Vdc measurements at a rate of approximately 12 measurements/sec.

Current Measurement with Low Voltage Drop

For measurements up to 1 mA the PM 2525 is equipped with a unique current-compensation system that virtually eliminates voltage drops across the meter input, eliminating a common source of significant errors in low current measurements.

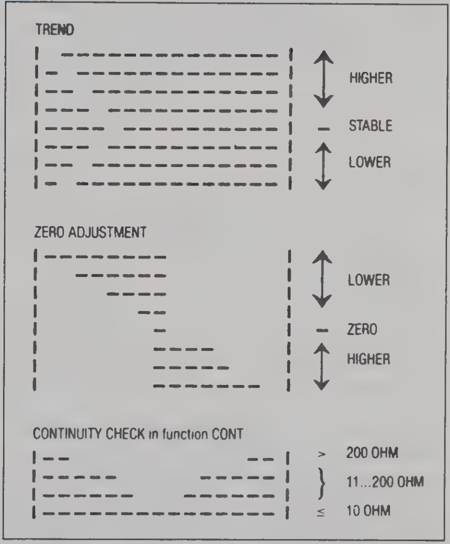
** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

More Functions, More Value

	Ranges	Resol.	Accuracy
VDC	5	1 μV	0.02%
VAC	5	10 μV	0.3%
VTrms	5	10 μV	0.3%
Vpeak	4	1 mV	1.0%
IDC	8	100 pA	0.1%
IAC	8	100 pA	0.4%
R (2-wire)	7	10 mΩ	0.1%
R (4-wire)	5	10 MΩ	0.1%
Hz	4	0.1 Hz	0.01%
Capacitance	6	1 pF	1.0%
Time	5	10 μsec	0.01%
Temperature	—	0.1°C	0.3%
Diode	—	100 μV	
dBm	5	0.1 dB	1.0%

Trend Display with an Analog Bargraph

The PM 2525 has an analog bargraph display for optimal presentation of signal trends and precision detection of peak, through or null value, which is particularly valuable for peak tuning of communication equipment, for example. The rotating bargraph indicator on the LCD display steps in proportion to the voltage trend. With a 5V signal, the resolution is 0.01V per step, much higher than can normally be achieved with conventional analog multimeters.



Relative Measurements

Adjustments are easily made by presetting a value as a reference zero by a single touch of the zero-set button. Deviation, positive or negative from the set zero, is then immediately and clearly displayed. Also the bargraph function can be used in the same way so that the bargraph then acts as a very sensitive minus-null-plus indicator.

PM 2525

Overload Protection

The PM 2525 also includes comprehensive overload protection. All voltage ranges can handle peak transients of up to 2.5 kV without damage, while all other ranges are protected against accidental connection to normal power supplies. The instrument is electronically protected on current ranges up to 1 mA and by a fuse for the 10 mA and 100 mA ranges. The 1A and 10A ranges have a separate input socket.

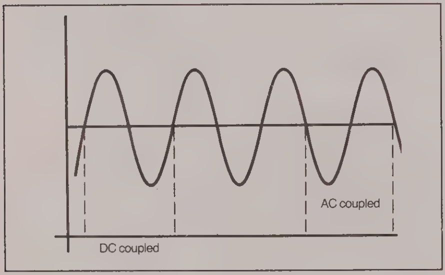
Fast Result with MIN/MAX, Peak-Peak, dBm

A number of special measuring capabilities not only makes measurement easier but allows the user to reach conclusions faster. For practically all measurements the MIN/MAX function can be switched in. This function displays the maximum and minimum reading over a given period, for all measurement functions. Volt peak-peak gives the instant peak voltage. A selection can be made for positive, negative or peak-to-peak values. So, too, can adjustments be made more easily by using the dBm function.

For both current and voltage, the measurement can be read in dBm's. And, since the reference resistance can be easily selected as well, levels can be quickly compared to a known reference.

Choice of AC- or DC-Coupled True RMS Measurements

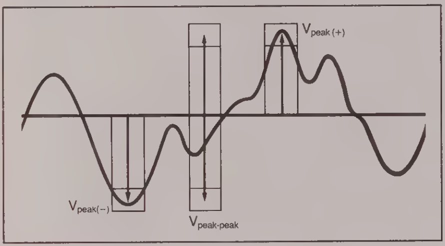
For accurate measurements of AC and AC + DC signal components regardless of the waveform.



True RMS measurements are only possible with DC coupling since the DC component is an important part of the total signal energy. But AC coupling is essential for accurate measurements of AC components on large DC signals. The PM 2525's RMS measurement function always gives accurate RMS readings in both AC- and DC-coupled modes and even with highly distorted signal waveforms.

Accurate Measurement of Peak Values

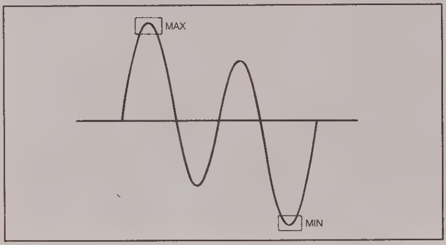
Direct measurement of positive, negative and peak-to-peak values.



This function is valuable for measuring ignition or discharge voltages, as well as for measuring crosstalk between lines, and in electronic circuit design. In combination with Min./Max. mode, the V_{peak} function allows the peak value of disturbances on a signal to be measured over an extended monitoring period.

Convenient Min/Max Measurements

For minimum and maximum values over extended monitoring periods.

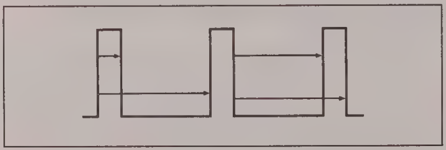


Min./Max. level monitoring throughout the duration of a measurement is easy and convenient with the PM 2525. Measured Min./Max. values are stored until replaced by lower or higher values, and can be recalled and displayed at any time.

This function is useful to measure low-frequency signals (in order of 1 Hz), when the maximum and minimum values can be readout within a few seconds. It also allows highest and lowest temperature values over extended periods to be measured simply and conveniently.

Time and Frequency Measurements

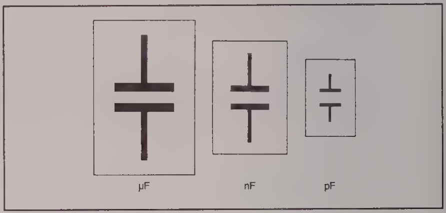
Extra versatility through high-resolutions time and frequency functions.



One of the PM 2525's extra measuring capabilities is a useful time function with a range of up to 100,000s and a maximum resolution of 10 µs. Freely programmable start and stop edges enable all periods and pulse width measurements to be made in a repetitive or single trigger mode. Two different frequency measurements are possible. In the normal mode there is a resolution of 1 Hz, but in the 'High resolution' mode a resolution of 0.1 Hz can be achieved. Maximum frequency is 20 MHz.

Capacitance Measurements

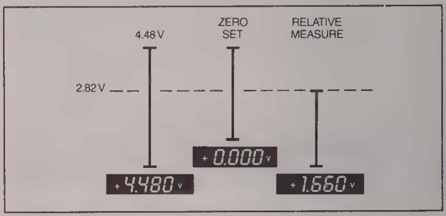
For measuring unknown devices or lead capacitances.



The PM 2525's capacitance function is unmatched in its class. The capacitance of any unknown device, or even of PCB tracks, can be measured directly in a wide range from 20 nF right up to 200 µF, down to a resolution of 1 pF. High noise immunity ensures stable readings at all times, even when using normal DMM test leads, thereby eliminating the need for special guarded leads. Cable capacitance can even be compensated using the zero-set function.

Simple Zero-Setting for Relative Measurements

Direct measurement of tolerances or deviations from any preset value.

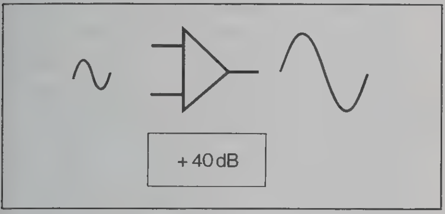


Zero-setting to use any value for relative reference measurements is done simply with the PM 2525, simply by pressing the ZERO button. This principle allows tolerance measurements, or component deviations from specified values, to be measured directly, and eliminates the need to make all measurements as absolute values.

PM 2525

Direct dB Read-Out

AC and DC voltages shown as dB values to any zero reference level. And with user programmable reference resistance.



This function allows VAC and VDC measurements to be read-out directly as dB values, saving time-consuming calculations. dB measurements are made against an absolute or selectable zero reference level. It is also possible to program a different reference resistance.

Direct dB read-outs are essential for measurements on amplifier gains and losses, or on communications equipment. The dB function can also be used in conjunction with the zero-set mode for 'end-to-end' amplifiers measurements.

Simple Command Structure

The PM 2525 can be used within a system via its IEEE-488 bus interface. In such a system, procedures are programmed using a simple command structure which eliminates complex codes by using straight-forward English statements.

To ease communication with both user and computer, the PM 2525 accepts numeric ranging values in either decimal or exponential notation, and automatically rounds-off to the correct range. To overcome the often lengthy and complex task of splitting the numerical data from the output string, the PM 2525 has an "OUT N" command by which only the numeric value is transferred.

Closed-Case, Electronic Calibration

The PM 2525 can be electronically calibrated and tested without opening the case, if the unit is equipped with an IEEE-488 or RS 232 interface. This function offers substantial time and cost savings and ensures that measurements are always made at optimum accuracy.

Multipoint, Multifunction Measurements

If a system measurement application requires measurements to be made at a number of different points the PM 2525, combined with the Philips System 21 switching system and a IEEE-488 controller, is the cost-effective answer.

This high performance combination can handle any number of single-, dual- or 4-pole measurements at a much lower cost than would be possible with normal large and expensive scanners. Moreover, as it is based around the PM 2525, functions such as frequency, time and peak measurement are also possible, further extending the versatility of remote controlled operation.

Specifications

Technical Specifications

DC Voltage

Range: 200 mV...1000V
Resolution (Norm-mode/HR mode): 10 µV/1 µV
Accuracy: ±0.02% of reading ±0.01% of range
Temperature Coefficient: ±0.003% of reading ±/°C
Input Impedance: ≥10 MΩ//≤90 pF
Offset Current in Input: <20 pA
SMMR (49.95...50.05 Hz): 80 dB
Maximum SM Signal: 2 x range (except 2000V range)
CMRR (For DC and 50 Hz): 120 dB
Maximum CM Voltage: 250V RMS: 350V peak
Response Time
Without ranging: 0.8s; With ranging: 1.5s
Maximum Input Voltage
Hi and Lo: 1000V RMS
Hi and Earth: 1000V RMS
Lo and Earth: 250V RMS
Max. V-Hz Product of Input Signal: 10^7

AC Voltage True RMS (AC or DC Coupled)

Range: 200 mV...1000V
Resolution: 10 µV
Accuracy*
40...100 Hz: ±0.3% of reading ±0.1% of range
0.1...20 KHz: ±1% of reading ±0.1% of range
20...100 KHz: ±5% of reading ±0.5 of range**
Temperature Coefficient: ±0.03% of reading ±0.01% of range/°C
Input Impedance: ≥10 MΩ//≤90 pF
CMRR: For DC: 120 dB; For 50 Hz: 60 dB
Response Time
Without ranging: 1.5s; With ranging: 2s
Crest Factor: 2 at full scale, increasing down scale
Maximum Input Voltage
Hi and Lo: 750V RMS
Hi and Earth: 750V RMS
Lo and Earth: 250V RMS
Maximum V-Hz Product: 10^7

**Additional error for DC-component ±0.2% of reading ±0.1% of range*
***20% in 200 mV range*

DC Current

Ranges: 1 µA...10A
Resolution: 0.1 nA
Number of Counts: Normal mode: 11000
Accuracy: ±0.1% of reading ±0.05% of range
Temperature Coefficient: ±0.01% of reading ±0.005% of range/°C
Voltage Drop Full Scale
1 µA...1 mA: <2.5 mV
10 mA/1A: <40 mV
100 mA/10A: <400 mV
Response Time
Without ranging: 0.8s; With ranging: 2.5s
Protected for 1 µA...100 mA up to: 250V RMS
Max. Input Voltage (common mode): 250V RMS, 350V peak

AC Current True RMS (AC or DC Coupled)

Ranges: 1 µA...10A
Resolution: 0.1 nA on 1 µA range
Number of Counts: Normal mode: 11000
Accuracy (3% - 100% of range): ±0.4% of reading ±0.15% of range
Temperature Coefficient: ±0.04% of reading ±0.015 % of range/°C
Frequency Range: 40 Hz...200 Hz
Voltage Drop
1 µA...1 mA: <2.5 mV
10m and 1A: <40 mV
100 mA and 10A: <400 mV
Crest Factor: 4 at full scale, increasing down scale
Response Time
Without ranging: 1.5s; With ranging: 3s
Protected for 1 µA...100 mA up to: 250V RMS
Max. Input Voltage (common mode): 250V RMS, 350V peak

Ohms

Ranges two-wire: 200Ω..100 MΩ
Ranges four-wire:200Ω...2 MΩ
Maximum Lead Resistance (4 wire): 2Ω
Resolution: 10 mΩ
Number of Counts
200Ω...20 MΩ: 21000; 100 MΩ: 1000
Accuracy
200Ω - 200 KΩ: ±0.1% of rdg ±0.05% of range
2 MΩ - 20 MΩ: ±0.5% of rdg ±0.1% of range
100 MΩ: ±5% of reading ±1% of range
Temperature Coefficient
200Ω- 200 KΩ: ±0.01% of reading ±0.005% of range/°C
2 MΩ - 20 MΩ: ±0.05% of reading ±0.01% of range
100 MΩ: ±0.5% of reading ±1% of range/°C
Measuring Current for each Range: 1 mA, 1 mA, 100 µA, 10 µA, 1 µA, 100 nA, 10 nA
Open Input Voltage: 14V
Response Time (200Ω - 200 KΩ)
Without ranging: 0.8s; With ranging: 2.5s
Response Time (2 MΩ - 20 MΩ)
Without ranging: 2s; With ranging: 3.5s
Response Time (100 MΩ)
Without ranging: 9s; With ranging: 10s
Input Protection: Up to 250V RMS

Peak Voltage

Range: 2V...1000V
Resolution: 1 mV
Number of Representation Units: 2100
Accuracy: ±1% of reading ±1% of range
Temperature Coefficient: ±0.15% of rdg/°C
Input Impedance: ≥10 MΩ//≤90 pF
Measuring Time: 500m sec.

PM 2525

+Continuous Wave Mode:
min pulse width: 5µ sec
min period: 100µ sec for min duration of 500m sec
+Single Shot Mode:
min pulse width: 350m sec
min period: 500m sec synchronized with trigger
Frequency Range (except DC): 20 Hz...200 KHz* Response Time
Peak without ranging: 1 sec.
Peak with ranging: 2.5 sec.
Peak-peak without ranging: 1.5 sec.
Peak-peak with ranging: 5 sec.
Maximum Input Voltage
Hi and Lo: 600V AC or DC or 1000V peak
Hi and Earth: 600V AC or DC
Lo and Earth: 250V AC or DC
Max. V-Hz Product: 10^7
CMMR: DC: 120 dB; MHz: 60 dB

** For 200V range max. 60 Hz*

Frequency

Measurement Range: 1 Hz...20 MHz
Ranges: 10 KHz, 100 kHz, 1 MHz, 10 MHz and 20 MHz
Minimum Frequency: 10 Hz
Resolution (High speed): 1 Hz; High resolution: 0.1 Hz
Number of Counts (10 KHz...10 MHz)
High speed: 10000; High resolution: 100000
Number of Counts (20 MHz)
High speed: 2000; High resolution: 20000
Accuracy: ±0.01% of reading ±2 digits
Temperature Coefficient: ±0.001% of rdg /°C
Response Time (100 KHz...20 MHz)
Without ranging: Normal mode 0.3s
With ranging: Normal mode 0.5s
Without ranging: High resolution 2.5s
With ranging: High resolution 3s
Response Time (10 KHz)
Without ranging: Normal mode 1.5s
With ranging: Normal mode 2s
With ranging: High resolution 13s
Impedance: 10 MΩ//50 pF
Coupling: AC
V-Hz Product for Voltage <5V max.: 10^7
Maximum Input Voltage: 250V
Sensitivity
10 Hz...100 Hz: 1V peak
100 Hz...10 MHz: 250 mV peak
10 MHz...20 MHz: 500 mV peak

Time

Range: 1...105 sec.
Resolution: 10 µsec.
Number of Counts: 99999
Accuracy: 0.01% of reading
Hold-Off Time: 30 µsec.
Start/Stop: Positive or negative slope selectable
Trigger Level: µ0.5V
Modes: Repetitive or single trigger

Capacity

Ranges: 10 nF...2000 µf
Resolution: 1 pF
Number of Counts: 21000
Accuracy: ±1%* of reading ±0.1% of range
Temperature Coefficient: ±0.1%* of reading ±0.01% of range/°C
Measuring Current (for each range): 100 nA, 1 µA, 10 µA, 100µA, 1 mA, 1 mA
Open Input Voltage:≤2.5V
Polarity Input Socket: + on Lo
Response Time (without ranging): 1s
Response Time (with ranging): 1.5s
Protected up to: 250V

** For 2000 µF range 10%*

Continuity

Driving Current: 1 mA
Short circuit: Audible tone from 0...10Ω
Isolation: Resistance <10Ω no tone
Response Time: <0.15s

Diode

Driving Current: 1 mA
Response Time: 0.Ωs
Range: 2000.0 mV
Resolution: 0.1 mV
No. of Counts: 20,000
Max. Input Voltage: 250V

Temperature*

Range:-100°C...+850°C
Resolution: 0.1°C
Number of Counts: 8500
Accuracy (excl. probe): ±0.3% of rdg ±0.3°C
Temperature Coefficient: ±0.03% of reading ±0.003% of range/°C
Measuring Current: 1 mA
Response Time (excl. probe): 0.5s
Linearization: Probe characteristics is linearized within limits stated in DIN 43760

** For temperature additional PM 9249/01 or Pt 100 element is required.*

dB Measurement

dB Reference: 1 mW in reference resistance
Reference Resistor (programmable): 0.0001...9999Ω
Resolution: 0.1 dB
Number of Counts: 8500
Accuracy: ±0.2 dB
Input Impedance: <10 MΩ//<90 pF
CMMR (DC): <120 dB
Response Time: 1.5s

DC Ranges*

Range (600Ω): -77...+62.2 dB
Resolution of Signal <1 mV: 1 dB
Number of Counts if signal <1 mV: 99
Accuracy (if signal <1 mV): ±1 dB
Temperature Coefficient: ±0.0013 dB/°C

AC Ranges*

Range (600Ω): -57.5...+57.5 dB
Accuracy (20 KHz...100 KHz): ±3 dB
Add. Accuracy for DC Component: ±0.2 dB
Temperature Coefficient: ±0.02 dB/°C

** If not specified: see DC VOLTAGE and AC VOLTAGE True RMS.*

Interfaces (Optional)

Three interfaces are available:

(1) The **GPIB** (IEEE-488/IEC-625 compatible) makes it possible to operate in an automatic measurement environment.
Interface Functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1
Programmable: All functions and all ranges

(2) The **RS-232** interface offers a low cost solution for computer control of the interface. The so-called 'Multidrop' mode allows a number of devices to be controlled by the same computer. Selection of the device is made by SOH or STX followed by a selected character.
Interface Functions
Baud Rate: 110...9,600 baud
Stop Bits: 1 or 2
Parity: Odd, even or no
Length: 7 or 8
Input connector: 25 pin male
Handshake: Hardware or software

(3) The **analog output** allows the selective monitoring of a part of the digital display and is scaled between 0 and 1 Volt. A selection can be made which part of the display will be sent to the output.
Output Voltage: 0...1V
Accuracy: ±0.25% of reading ±0.25% of range
Temperature Coeff.: ±0.025% of reading ±0.01% of range
Output Resistance: 200Ω

General Specifications

Power Supply
High Range: 196V...258V, 50 Hz
Low Range: 98V...129V, 60 Hz
Power Consumption: 12 VA
Operating Time (Full Charge): >5 hrs
Charging Time: <15 hours
Temp. Limits of Operation: 0...+45°C
Low Battery Indication: On display

Environmental Conditions

Reference Temperature: +23°C ±1°C
Rated Range of Use: 0°C...+40°C
Operating Range: 0°C...+50°C
Storage and Transport Range: -40°C...+70°C
Humidity Operating Limits: 20...80%
Maximum Dew Point: +26°C
Storage and Transport: 5...95%
Emission: CISPR publ. 11 and 14, VDE 871-B, VDE-875-K acc. to Vfg 1046/84
Safety Class: IEC 348 class II
Calibration Interval: 1 year
Dimensions: 287 L x 210 W x 86 H mm (11.3 in L x 7.3 in W x 3.4 in H)
Weight: 2.5 kg (5.5 lb)

Included With Instrument: 2 measuring leads and probes, Operating manual

PM 2525

Ordering Information

Model	January 1989 prices
PM 2525 Digital Multimeter	$795

Optional Configurations*

When ordering, select the basic "PM" model desired from above and add the configuration option number listed below as a suffix.

/013 Standard Bench Unit	N/C
/213* DMM with built-in battery pack	add 100
/513 DMM with GPIB IEEE-488 Interface*	add 200
/613 DMM with RS-232C Multidrop Interface*	add 200
/713 DMM with analog output	add 200

Accessories (Also see page 127)

PM 2193/01 19-inch Rackmount Kit	$235
PM 9210 HF Probe	259
PM 9213 HF Probe	69
PM 9244 AC/DC Current Shunt	69
PM 9245 AC Current Transformer	65
PM 9246/03 HV Probe	149
PM 9249/01 Pt 100 Temperature Probe (2)	150
PM 9260/00 Pair of Test Leads with Probes	30
PM 9264/01 4-wire Resistance Measurement Cable (1)	85
PM 9266/02 Pair of Safety Test Leads with Probes	39
PM 9267/01 Data Hold Probe (1)	150
PM 9877J/2 Thermocouple Linearizer	200
PM 9877K/2 Thermocouple Linearizer	200

**Factory installable only*

Service & Support

Warranty

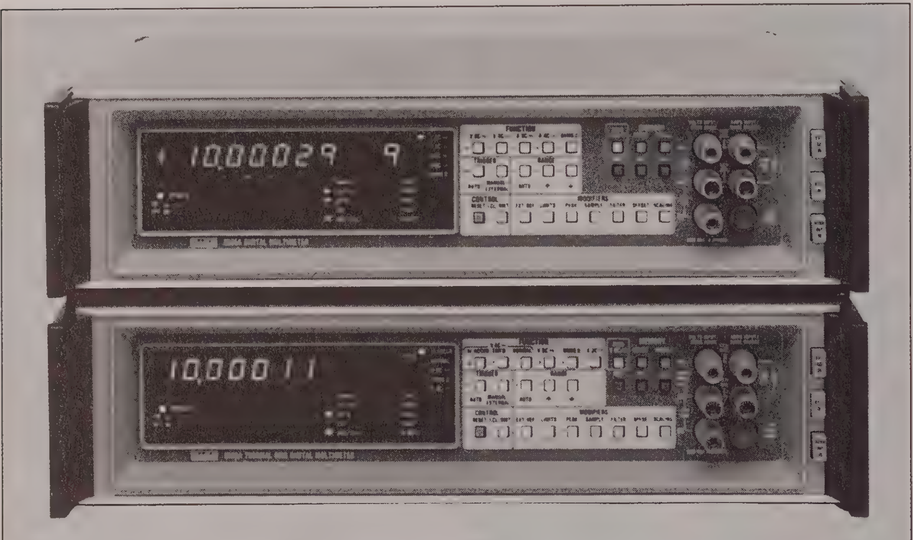
One-year product warranty. (See page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see page 491.

8506A & 8505A

GPIB
IEEE-488

RS-232


(NSN 6625-01-234-4134) **8505A & 8506A**

8505A Digital Multimeter

- 5 ppm dc accuracy, 100 nV (nanovolt) sensitivity
- 500 readings per second with 6-1/2 digit resolution
- AC (8505A only), ohms, current module options
- GPIB/IEEE-488, RS-232-C, and parallel interfaces
- Front-rear switchable input standard in basic mainframe
- Software calibration from front panel or remote interface
- Modular construction for application flexibility

8506A Thermal RMS Digital Multimeter

- 8505A features plus
- 120 ppm 24 hour ac accuracy, 40 Hz to 20 kHz
- Full accuracy for crest factors as high as 8:1
- 25 ppm short-term ac stability
- Frequency response specified to 1 MHz
- AC-DC transfer accuracies with DMM speed & convenience

The 8505A and 8506A Digital Multimeters are Fluke's most advanced bench/system DMMs. Both models excel in dc accuracy, resolution, versatility and speed.

The 8506A uses a fast thermal rms sensing technique for measuring ac which very significantly advances the state-of-the-art for ac measurements using a system DMM: It is several times more accurate than the calculating type of true-rms converter and is unmatched by any other DMM. Basic ac accuracy uncertainty is reduced to 120 parts per million 24 hour for frequencies from 40 Hz to 20 kHz. That approximates the accuracy you can expect using traditional thermal transfer techniques that typically take several minutes for each measurement. Short term stability is 25 ppm. Accuracy is specified from 10 Hz to 1 MHz and non-sinusoidal waveforms having crest factors as high as 8 to 1 can be measured with full 90-day accuracy.

Software Calibration

Both the 8506A and 8505A have a "software calibration" feature that makes it easy to store correction factors for every range of any measurement function. You can update the 24-hour accuracy specifications daily, or whenever the need arises without having to remove the covers. Nor do you need to use a cardinal point standard for a reference. Any reference having a suitably accurate value between 60% of range and full scale will do. This "software calibration" is managed with a few keystrokes on the front panel or even remotely when used as part of a test and measurement system.

Measurement Speed

Most system DMM manufacturers use an integrating technique for A-to-D conversion. That means there must be a compromise between resolution and reading speed. The 8505A and 8506A use a Fluke patented "recirculating remainder" technique for A-to-D conversion that does not compromise 6-1/2 digit resolution at reading speeds up to 500 per second for dc voltage measurements. Front or rear measurement inputs are switch-selectable from the front panel. For system applications the position of the switch can be sensed through the interface. An external trigger input is included to control the timing of measurements remotely. And, to control the switching time of an external scanner, scanner-advance output pulses are available at the rear panel.

Either GPIB/IEEE-488*, RS-232-C, or an 8-bit/16-bit parallel interface option may be used for systems applications. The parallel interfaces will work with DEC computer interfaces DR11C or DRV11.

Math Power

The 8506A and 8505A are controlled by an internal microprocessor and have built in math power to add, subtract, multiply, and divide as well as store and compare numerical information. Each measurement may be made a part of a calculation before being displayed or recorded. Stored HI and/or LO limit values may be repeatedly compared to measured values to determine out-of-tolerance conditions, HI, LO, or PASS indications may appear directly in the display. The highest and lowest values in a series of measurements may be stored and later displayed. And measurements may all be in terms of ± deviations from a stored "offset" value. In general, any calculation is possible based on the general formula.

Y = mx+b
Where m = scaling factor (multiplier),
x = value measured,
b = the ± offset, and
Y = the numerical result

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

8506A & 8505A Differences

The 8505A is Fluke's lowest cost DMM having top dc accuracy, resolution, and speed. Two options for measuring ac voltage are available either an ac average-sensing, rms-indicating option (-01) for sinewaves or an ac true-rms option (-09A) for either sinewaves or non-sinusoidal waveforms. An option for measuring current (-03) and an option for measuring resistance (-02A) are also available for the 8505A. For measuring ac current, an ac voltage option (-01 or 09A) must also be installed. An 8505A, when fully equipped, will measure dc and ac voltage, dc and ac current, and resistance.

The 8506A and 8505A have identical dc measurement capabilities but the 8506A requires no option for measuring ac voltage. State-of-the-art ac voltage measurement capabilities are built in. An option for measuring dc current may be installed (-03) or an option for measuring resistance may be installed (-02A), but not both at the same time. Any external dc reference voltage up to 40 volts that is applied at the rear panel may be compared and the relative values displayed as a ratio. The same interface options are available for the 8506A as for the 8505A.

8506A Specifications

Technical Specifications

DC Voltage

All dc voltage accuracy and stability specifications apply after a two-hour warm-up unless otherwise noted. The 24-hour specifications are relative to the calibration standards used.

Input Characteristics

Range	Full Scale 6-1/2 Digits	Resolution 7-1/2* Digits	Resolution 6-1/2 Digits	Input Resistance
100 mV	200.0000 mV	–	100 nV	≥10,000 MΩ
1V	2.000000V	–	1 µV	≥10,000 MΩ
10V	20.00000V	1 µV	10 µV	10,000 MΩ
100V	128.0000V	–	100 µV	10 MΩ
1000V	1200.000V	–	1 mV	10 MΩ

*In AVG operating mode

Accuracy, Normal Mode, 6-1/2Digits: ±(% of Rdg + Counts)

Range	24 Hours* 23°C ±1°C	Long Term 18°C to 28°C: Up to 90 Days	Long Term 18°C to 28°C: Add Per Mo Over 90 Days
100 mV	0.0018+15	0.0025+40	0.00017+5.6
1V	0.0008+7	0.0015+8	0.0001+0.1
10V	0.0006 or 6**	0.0010+8	0.0001+0.1
100V	0.0010+6	0.0018+8	0.00013+0.1
1000V	0.0008+6	0.0018+8	0.00013+0.1

*After 4-hour warm-up & within 1 hour of zeroing dc
**Whichever is greater

Accuracy, AVG Mode, 6-1/2Digits: ±(% of Rdg + Counts)

Range	24 Hours* 23°C ±1°C	Long Term 18°C to 28°C: Up to 90 Days	Long Term 18°C to 28°C: Add Per Mo Over 90 Days
100 mV	0.0010+8	0.0020+8	0.0001+0.1
1V	0.0005+4	0.0012+6	0.0001+1**
10V	0.0005 or 50***	0.0008+60**	0.00008+1**
100V	0.0005+5	0.0015+6	0.0001+0.1
1000V	0.0005+5	0.0015+6	0.0001+0.1

*After 4-hour warm-up & within 1 hour of zeroing dc
** 7-1/2 digit mode of operation
*** Whichever is greater

Accuracy, Software Calibration

Fully restores above "24-hour" accuracy for 24 hours each time performed within 30 days after hardware calibration is performed. After 30 days add the following number of counts to the 24-hour accuracy specifications.

Time Since Internal (Hardware) Calibration	Number of Counts to be Added: 6-1/2 Digits	Number of Counts to be Added: 7-1/2 Digits
Less than 30 Days	0	0
30 to 90 Days	1	10
90 Days to 1 Year	2	20
More than 1 Year	3	30

Temperature Coefficient: ±(% of Rdg+Counts) /°C

Range	0°C to 18°C and 28°C to 50°C
100 mV	0.0003+5
1V	0.0003+1
10V	0.0002+0.5*
100V	0.0003+1
1000V	0.0003+0.5

* With 6-1/2 digit display. For 7-1/2 digit display, multiply Number of Counts by 10.

Input Bias Current

At Time of Adjustment	1 Year 23°C ±1°C	Temperature Coefficient
<±5 pA	<±30 pA	<±1 pA/°C

Zero Stability: Less than 5 µV for 90 days after a four-hour warm-up. Front panel pushbutton zero is provided for permanent storage of a zero correction for each range. Zero may be turned off at any time.

Normal Mode Rejection

Line Frequency	Filter Mode	4 Samples Per Reading	32 Samples Per Reading	128 Samples Per Reading
50 Hz	Fast	60 dB	70 dB	75 dB
50 Hz	Slow	85 dB	90 dB	95 dB
60 Hz	Fast	60 dB	70 dB	75 dB
60 Hz	Slow	90 dB	95 dB	100 dB

Common Mode Rejection: 160 dB at 60 Hz with 1 kΩ in series with either lead, and 4 samples or more per reading. Greater than or equal to 100 dB with less than 4 samples per reading.

Analog Settling Time

Filter Mode	Filter Command	To 0.01% of Step Change	To 0.001% of Step Change
Fast	F0 or F3	40 ms	50 ms
Slow	F or F2	400 ms	500 ms

Digitizing Time (Line Synchronous): For 2^0 to 2^{17} samples per reading the digitizing time is from 4 ms to 9 minutes 6 seconds using a 60 Hz line. Time increases 20% using 50 Hz ac line. Selectable in 1Ω binary steps.

Digitizing Time (Line Asynchronous): 2 ms in 3-byte binary mode with dc zero, offset, limits and calibration factors turned off

Maximum Input: ±1200V dc or 1000V rms ac to 60 Hz, or 1400V peak above 60 Hz may be applied continuously to any dc range without permanent damage. Maximum rate of voltage change is 1000V per µs.

Ratio (External DC Reference)

Voltage, resistance, or current may be measured and compared to an external dc voltage and displayed as a ratio. Option -02A or -03 is required when measuring resistance or current. The dc reference voltage (V_{xref}) is applied to terminals on the back panel and is the denominator of the ratio.

Input Resistance: >10,000 MΩ between Ext Ref HI and LO and between either Ext Ref HI or LO and Ohms Guard or Sense LO

Max. Reference Voltage: ±40V between Ext Ref HI and LO terminals providing neither terminal is greater than ±20V relative to the Sense LO or Ohms Guard terminal

Min. Reference Voltage: ≥0.0001V when comparing voltage or current, and ≥0.0001V or 1 billionth of the absolute value of resistance, whichever is greater, when comparing resistance

Maximum Ratio Display: 10^{-9} to 10^{9}

Source Impedance: Resistive unbalance (Ext Ref HI to LO) <4 kΩ. Total resistance to Sense LO from either Ext Ref HI or LO <20 kΩ

Overload Voltage: ±180V dc or peak ac relative to Ohms Guard or Sense LO. ±360V dc or peak ac (Ext Ref HI to LO)

Normal Mode Noise Rejection: ≥100 dB for line frequency and 2x line frequency

Common Mode Noise Rejection: ≥75 dB for dc, line frequency, and 2x line frequency

8506A & 8505A

Ratio Accuracy

External Reference Voltage	Accuracy
±20V to ±40V	±(A + B + 0.001%)
±V_{min} to ±20V	±(A + B + (0.02% $\lvert V_{xref} \rvert$))

A = 10V dc range accuracy for the appropriate period of time
B = Input signal function and range accuracy for the appropriate period of time
V_{min} = Minimum allowable external reference voltage
$\lvert V_{xref} \rvert$ = Absolute value of the external reference voltage

Digitizing Time: 196 ms to 9 minutes and 6s for 2^0 to 2^{17} samples per reading using 60 Hz line, increasing 20% using 50 Hz line.

AC Voltage (Thermal RMS)

All ac voltage accuracy and stability specifications for 5-1/2 digit displays using at least 25% of full scale after a 2-hour warm-up. Except where noted, ac coupling is used to block dc. The 24-hour specifications are relative to the calibration standards used and within 1 hour of dc zero.

Range	Full Scale 5-1/2 Digits	Resolution		Input Impedance
		6-1/2* Digits	5-1/2 Digits	
100 mV	125.000 mV	–	1µV	
300 mV	400.000 mV	–	1 µV	
1V	1.25000V	1 µV	10 µV	1 MΩ
3V	4.00000V	1 µV	10 µV	±1%
10V	12.5000V	10 µV	100 µV	shunted by
30V	40.0000V	10 µV	100 µV	<180 pF
100V	125.000V	100 µV	1 mV	
500V	600.000V	100 µV	1 mV	

**In AVG operating mode*

Settling Time

High Accuracy Mode: Sample time is 3.5 seconds, hold time is 2.5 seconds. Measurement time is 6 seconds – the sum of sample time and hold time. If the state of the instrument is unknown, two complete measurement cycles will be required to guarantee a correct reading. Use of an external trigger will allow a 6-second measurement cycle.

Enhanced Mode: The first reading requires the same time as the high accuracy mode. Subsequent readings occur every 500 milliseconds. If the input changes 0.1% the analog settling time to 90-day mid-band accuracy is 1.5 seconds.

Normal Mode: Settling time for large changes is non-linear. Zero to full scale changes require 2.0 seconds to settle to 90-day, mid-band specifications. Full scale to 10% of full scale changes require 3.0 seconds to settle to mid-band, 90-day specifications. Small changes (<1%) settle to mid-band specifications in <1.5 seconds.

Autoranging: Upranges when input is higher than full scale. Downranges when reading is less than approximately 28% of full scale.

Accuracy, High-Accuracy Mode: ±(% of Reading)[1] 24 Hours, 23°C ±1°C[2]

Ranges	Frequency in Hertz						
	10** to 40	40 to 20k	20k to 50k	50k to 100k	100k to 200k	200k to 500k	500k to 1M
100 mV	0.08	0.02*	0.04*	0.2	0.6	1.5	3.5
300 mV to 10V	0.08	0.012	0.04	0.2	0.5	1.5	3.5
30V	0.08	0.012	0.05	0.2	0.5	3.5	12
100V	0.08	0.012	0.04	0.2	1.0	3.5	–
500V[3]	0.08	0.012	0.04	0.2	–	–	–

90 Days, 18°C to 28°C

100 mV	0.08	0.026*	0.06	0.2	0.6	1.5	3.5
300 mV to 10V	0.08	0.016	0.06	0.2	0.5	1.5	3.5
30V	0.08	0.016	0.06	0.2	0.5	3.5	12
100V	0.08	0.016	0.06	0.2	1.0	3.5	–
500V	0.08	0.016	0.06	0.2	–	–	–

>90 Days, 18°C to 28°C, per month. Add to the 90-day specification the following % of reading.

All	0.008	0.001	0.0025	0.012	0.021	0.06	0.11

**Add 5 digits (5 µV) to the % of reading*
***With Slow filter*

Accuracy, Enhanced Mode: Add the following (% of reading + number of digits) to the accuracy specifications of the high accuracy mode –

Ranges	Time Since First Reading	
	<5 Min	>5 and <30 Min
All except 500V	0 + 0	0.003 + 4
500V	0 + 0	0.003 + 6

Accuracy, Normal Mode: Add the following % of reading to the accuracy mode specification of the high accuracy mode –

Segment of Scale	24 Hour 90 Day	<90 Day Add Per Month
0.25 x to 1 x full scale	0.4	0.044
0.1 x to 0.25 x full scale	0.6	0.055

DC-Coupled (AC+DC) Accuracy: ±(1.1 times the appropriate ac-coupled specifications + a calculated "Adder" from the following table)

Range	Adder
100 mV-1V	±(150 µV x (dc volts/total rms volts))
3V & 10V	±(1 mV x (dc volts/total rms volts))
30V & 100V	±(10 mV x (dc volts/total rms volts))
500V	±(50 mV x (dc volts/total rms volts))

Notes:

[1] *AC coupled, 5-1/2 digits, input level >0.25 x full scale. For 6-1/2 digits multiply Number of Counts by 10. For input levels between 0.1 x and 0.25 x full scale, add 5 counts for the 100 mV, 1V, 10V, and 100V ranges, add 15 counts for the 300 mV, 3V, 30V ranges, and add 25 counts for the 500V range.*

[2] *Relative to calibration standards, within 1 hour of dc zero.*

[3] *Add 0.02 x (Input voltage/600)^2 % of Reading to the specification.*

Stability: 40 Hz to 20 kHz, <1°C Temperature Change

Range	±(% of Rdg + Counts)*	
	24 Hours	90 Days
100 mV, 1V, 10V, 100V	0.0025 + 1	0.004 + 1
300 mV, 3V, 30V	0.0025 + 3	0.004 + 4
500V	0.0025 + 5	0.004 + 6

**For 5-1/2 digit resolution*

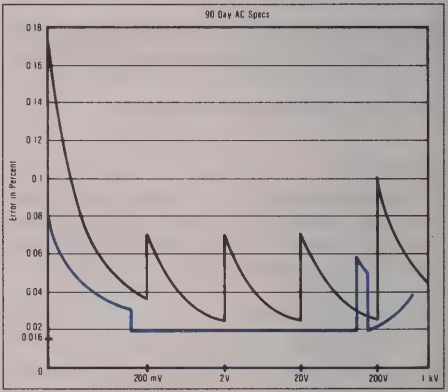
Crest Factor: Up to 8:1, with 90-day or greater accuracy for input signals with peaks less than two times full scale and high frequency components within the 3 dB bandwidth. Up to 4:1 for signals with peaks less than four times full scale, with the addition of 0.03 to the percent-of-reading specification.

3 dB Bandwidth (Typical): 3 MHz for the 100 mV range and 10 MHz for the 300 mV, 1V, 3V and 10V ranges

Maximum Input Voltage: ±600V dc or rms ac, 840V peak, or 1x10^7 volt-hertz product

Temperature Coefficient: One tenth of the 90-day accuracy specification per °C from 18°C to 0°C or 28°C to 50°C

Common Mode Rejection: >120 dB from dc to 60 Hz with 100Ω in series with either lead



This graph compares the total ac uncertainty of the 8506A's thermal rms converter to that of a typical computing rms converter used in other DMMs. The effects of floor error which cause large uncertainties at the beginning of each range are non-existent in the 8506A from 125 mV ac to 125V ac.

8506A Option Specifications

Resistance Option (-02A)

All resistance accuracy and stability specifications apply after a 2-hour warm-up. The 24-hour specifications are relative to the calibration standards used.

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution*		Current Through Unknown
		6-1/2* Digits	5-1/2 Digits	
10Ω	20.0000Ω	10 µΩ	100 µΩ	10 mA
100Ω	200.0000Ω	100 µΩ	6-1/2 Digits Only	10 mA
1kΩ	2.000000kΩ	1 mΩ		1 mA
10kΩ	25.0000 kΩ	10 mΩ		78 µA
100 kΩ	250.000 kΩ	100 mΩ		7.2 µA
1 MΩ	4.10000 MΩ	1Ω	10Ω	4.5 µA
10 MΩ	35.0000 MΩ	10Ω	100Ω	0.45 µA
100 MΩ	265.000 MΩ	100Ω	1 kΩ	56 nA

* *In normal operating mode, 5-1/2 or 6-1/2 digits depending on range. In AVG operating mode, 6-1/2 digits on all ranges.*

Open Circuit Voltage: 7V maximum from 10Ω through 100k range; 25V maximum from 1 MΩ range through 100 MΩ range
Maximum Input: ±400V dc or peak ac, continuous on any range with no damage
Analog Settling Time: 80 ms with Fast filter or 800 ms with Slow filter, to rated accuracy
Digitizing Time: Depending on sample rate and filter selection the digitizing time will vary from 145 ms to 9 minutes 6 seconds using a 60 Hz ac line. Time increases 20% using a 50 Hz line.

Accuracy, 5-1/2Digits: ±(% of Rdg + Counts)**

Range	24 Hours 23°C ±1°C	Long Term 18°C-28°C		Plus Temp Coefficient Per °C*
		Up to 90 Days	>90 Day, Add to % of Rdg Per Month	
10Ω	0.003+20	0.005+20	0.00056	0.0008+15
100Ω	0.002+1.4	0.003+1.4	0.00033	0.0007+0.2
1 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.2
10 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.2
100 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.5
1 MΩ	0.002+0.8	0.003+0.8	0.00033	0.001+0.5
10 MΩ	0.0075+0.8	0.02+0.8	0.0022	0.005+0.5
100 MΩ	0.026+0.8	0.05+1	0.0056	0.02+0.5

**From 18°C to 0°C or 28°C to 50°C*
***For 6-1/2digit display, multiply number of counts by 10*

Measurement Configuration: Two-wire and four-wire available on all ranges
Four-Wire Lead Resistance: Source leads should not exceed 10Ω for the 10Ω and 100Ω ranges, 100Ω for the 1 kΩ range, or 1 kΩ for the 10 kΩ or higher ranges

DC Current Option (-03)

All current accuracy and stability specifications apply after a 2-hour warm-up. The 24-hour specifications are relative to the calibration standards used. No ac current option is available for the 8506A.

Input Characteristics

Range	Full Scale 5-1/2 Digits	Resolution		Voltage Burden
		6-1/2* Digits	5-1/2 Digits	
100 µA	250.0000 µA	0.1 nA	1 nA	≤100 mV
1 mA	2.00000 mA	1 nA	10 nA	≤100 mV
10 mA	16.0000 mA	10 nA	100 nA	≤200 mV
100 mA	128.000 mA	100 nA	1 µA	≤200 mV
1A	1.28000A	1 µA	10 µA	≤500 mV

* *In AVG operating mode 100µA ac range is 5-1/2 digits only*

Accuracy, 5-1/2 Digits: ±(% of Rdg + Counts)**

Range	24 Hours 23°C ±1°C	Long Term 18°C-28°C		Plus Temp Coefficient Per °C*
		Up to 90 Days	>90 Day, Add to % of Rdg Per Month	
100 µA	0.02+10	0.03+10	0.0022	0.0025+0.6
1 mA	0.02+10	0.03+10	0.0022	0.0025+0.6
10 mA	0.02+10	0.03+10	0.0022	0.0025+0.6
100 mA	0.03+20	0.05+20	0.0056	0.0035+0.6
1A	0.03+20	0.05+20	0.0056	0.0035+0.6

**From 18°C to 0°C or 28°C to 50°C*
***For 6-1/2 digit display, multiply number of counts by 10*

Overload: 1.5A maximum, ±140V dc or peak ac to 60 Hz, or 200V peak ac above 60 Hz on any range with no damage. Protected by a 1.5A fuse.
Settling and Digitizing Time: Same as for dc volts

IEEE-488 Interface Option (-05)

This interface incorporates the following subset of the IEEE Standard 488-1978; SH1, AH1, T5, L4, SR1, RL2, DC1, DT1, and E1. The interface allows full control of all instrument functions and the transfer of ASCII or binary data. In the binary mode the instrument is capable of 500 readings per second.

RS-232 Interface Option (-06)

This interface is a bit serial asynchronous interface providing either voltage or 20 mA current loop level signals. The interface allows selection of baud rate from 50 to 9600, either one or two stop bits, and odd or even parity. Up to 40 ASCII character readings per second are possible with Option -06. No handshakes are provided.

Bit-Parallel Interface Option (-07A)

Permits you to connect the instrument to a DEC PDP11 minicomputer interfaces (DR11C and DRV11). The interface permits either 8- or 16-bit parallel ASCII transfers or 8- or 16-bit parallel binary transfers. In the binary mode the instrument is capable of up to 500 readings per second

8505A Specifications

Technical Specifications

DC Voltage

Same specifications as for 8506A

Ratio (External DC Reference)

Same specifications as for 8506A for dc ratio. AC/AC ratio available upon special request

8505A Option Specifications

Input Characteristics (-09A and -01)

Range	Full Scale 5-1/2 Digits	Resolution		Input Impedance
		6-1/2* Digits	5-1/2 Digits	
1V	2.50000V	1 µV	10 µV	MΩ shunted by <100 pF
10V	20.0000V	10 µV	100 µV	
100V	160.000V	100 µV	1 mV	
100V	1000.00V	1 mV	10 mV	

* *In AVG operating mode*

True-RMS AC Voltage Option (-09A)

All true-rms ac voltage accuracy and stability specifications apply to readings between 0.1% of range to full scale after a 2-hour warm-up. Options -09A and -01 may not be installed at the same time.

Accuracy: ±(% of Rdg + % of Full Scale)*

Frequency	90 Days, 19°C to 28°C		
	% of Input	+ % FS (AC)	+ % FS (AC + DC)
DC	0.1	–	0.03
10 Hz-20 Hz	1.0	0.04	0.06
20 Hz-50 Hz	0.5	0.012	0.03
50 Hz-10 kHz	0.1	0.012	0.03
10 kHz-30 kHz	0.2	0.04	0.06
30 kHz-50 kHz	0.3	0.1	0.12
50 kHz-100 kHz	1.0	0.3	0.3
100 kHz-300 kHz	2.0	0.5	0.5
300 kHz-1 MHz	3.3	1.8	1.8

**Slow filter must be used below 400 Hz. For inputs greater than 500V multiply the accuracy specification by: (200 + reading) ÷ 2000*

Common Mode Rejection: >120 dB, dc to 60 Hz, with 100Ω unbalance in either lead
Crest Factor: >7 at full scale, increasing down scale by

$$7 \times \sqrt{V_{Range} \div V_{Reading}}$$

Voltage & Frequency Limits: 1×10^7 volt-hertz product for the 1V and 10V ranges and 2×10^7 for the 100V and 1000V ranges
Analog Settling Time: 100 ms with Fast filter and 500 ms with Slow filter to within 0.1% of a step change within a range
Digitizing Time: Same as for dc voltage. See 8506A specifications

Averaging-Sensing AC Voltage Option (-01)

All average-sensing ac voltage accuracy and stability specifications apply to a 5-1/2 digit display with readings between 0.1% of range to full scale after a 2-hour warm-up. Option -01 and -09A may not be installed at the same time.

Accuracy: ±(% of Rdg + Counts)*

Frequency	90 Days, 18°C to 28°C	
	1 mV to 500V**	Above 500V
30 to 50 Hz	0.5 + 5	0.55 + 5
50 Hz to 10 kHz	0.05 + 5	0.1 + 5
10 to 40 kHz	–	0.15 + 5
10 to 50 kHz**	0.1 + 5	–
50 to 100 kHz**	0.5 + 5	–

*Slow filter must be used below 400 Hz. For 6-1/2 digit display, multiply number of counts by 10

**On 1-volt range add 7 counts above 10 kHz or 35 counts above 50 kHz

Common Mode Rejection: >120 dB, dc to 60 Hz with 100Ω inbalance in either lead
Voltage & Frequency Limits: 1000V rms (1400V peak) or 2x10^7 volt-hertz product, whichever is less
Analog Settling Time: 100 ms with Fast filter and 500 ms with Slow filter to within 0.05% of a step change within a range
Digitizing Time: Same as for dc voltage. See 8506A specifications

Resistance Option (-02A)

Same specifications as for 8506A

DC and AC Current Option (-03)

All accuracy and stability specifications apply after a 2-hour warm-up
Input Characteristics: Same as for 8506A
DC Current Accuracy: Same as for 8506A

AC Current Accuracy, 8505A only: ±(% of Rdg + Counts)*

Range	Frequency	90 Days, 23°C ±5°C	
		Opt -01	Opt -09A
100 µA	10 Hz - 20 Hz	–	1.0 + 110
	20 Hz - 50 Hz	0.8 + 9	0.8 + 35
	50 Hz - 10 kHz	0.4 + 9	0.4 + 35
	10 kHz - 20 kHz	0.7 + 9	1.0 + 110
	20 kHz - 50 kHz	1.5 + 9	1.5 + 260
	50 kHz - 100 kHz	3.0 + 9	4.0 + 760
1 mA and 10 mA	10 Hz - 20 Hz	–	1.0 + 110
	20 Hz - 50 Hz	0.5 + 9	0.5 + 35
	50 Hz - 10 kHz	0.06 + 9	0.11 + 35
	10 kHz - 20 kHz	0.11 + 9	0.2 + 110
	20 kHz - 50 kHz	0.12 + 9	0.3 + 260
	50 kHz - 100 kHz	0.51 + 9	1.0 + 760
100 mA	10 Hz - 20 Hz	–	1.0 + 150
	20 Hz - 50 Hz	0.5 + 55	0.5 + 80
	50 Hz - 10 kHz	–	0.26 + 80
	50 Hz - 100 kHz	0.24 + 55	–
1A	10 Hz - 20 Hz	–	1.0 + 160
	20 Hz - 50 kHz	0.5 + 65	0.5 + 90
	50 Hz - 10 kHz	0.24 + 65	0.26 + 90

*With 5-1/2 digit display. For 6-1/2 digit display, multiply number of counts by 10. AC Voltage Option -01 or -09A must also be installed to measure ac current

Crest Factor: (Using Option -09A) >4.5 at full scale, increasing down scale by

$$4.5 \times \sqrt{I_{Range} - I_{Reading}}$$

Maximum Overload: 1.5A maximum, ±140V dc or peak ac to 60 Hz, or 200V peak ac above 60 Hz on any range with no damage. Protected by a 1.5 fuse
Settling and Digitizing Time: Same as dc volts

IEEE-488 Interface Option (-05)

Same specifications as for 8506A

RS-232 Interface Option (-06)

Same specifications as for 8506A

Bit-Parallel Interface Option (-07A)

Same specifications as for 8506A

General Specifications

Maximum Terminal Voltage:
LO to Guard, 127V rms
Guard to Chassis, 500V rms
HI Sense to HI Source, 127V rms
LO Sense to LO Source, 127V rms
HI Sense to LO Sense, 1000V rms or 1200V dc
HI Source to LO Source, 280V rms
Trigger Input: TTL level, ±30V maximum, factory wired for falling edge; may be rewired for rising edge. Pulse width ≥10 µs
Scanner Advance Pulse: TTL level, ≥3 µs width
Shock & Vibration: Meets requirements of MIL-T-28800C for Type III, Class 5, Style E equipment
Temperature: 0°C to 50°C, operating; -40°C to 70°C, non-operating
Relative Humidity: ≤80% to 18°C, ≤75% to 40°C, ≤45% to 50°C
Size: 10.8 cm H x 43.2 cm W x 42.5 cm D (4.25 in x 17 in x 16.75 in)
Weight: 10 kg (22 lb) basic, 12 kg (26 lb) fully loaded
Power: 100, 120, 220 or 240 volt, 47-63 Hz, switch selectable
Included: Manual, power cord, serialized and dated calibration certification sheet

Ordering Information

Models

January 1989 prices

8506A Thermal RMS Digital Multimeter	$6990
8505A Digital Multimeter	3495

Options (for 8506A & 8505A)**

-02A Ohms Converter [1]	550
-03 Current Converter [1, 2]	550
-05 IEEE-488 Interface [3]	550
-06 RS-232-C Interface [3]	550
-07A Parallel Interface (for DEC PDP11, DR11C, DRV11) [3]	550
-07D Duplex parallel interface for all others (user configured) [3]	550

[1] Cannot install both -02A and -03 in 8506A at the same time

[2] Provides only dc current when installed in 8506A

[3] Only one interface may be installed

Options (for 8505A only)

-01* AC Converter (Average)	650
-09A* AC Converter (True-RMS)	735

*Cannot install both -01 and -09A at the same time

Accessories (Also see page 127)

MIS-7011K Extender Card	175
MIS-7013K Bus Interconnect & Monitor	85
MIS-7190K Static Test Controller	375
MIS-7191K Test Module	485
M00-260-610 18" Rack Slide Kit (needs M04-205-600)	130
M00-270-610 20" Rack Slide Kit (needs M04-205-600)	130
M00-280-610 24" Rack Slide Kit (needs M04-205-600)	130
M04-205-600 5-1/2" Rack Adapter	95
Y8021 1m, IEEE-488 Shielded Cable	130
Y8022 2m, IEEE-488 Shielded Cable	145
Y8023 4m, IEEE-488 Shielded Cable	155
Y8077 Four Terminal Short	35
Y8133 Universal Test Leads	22

Service & Support

Warranty

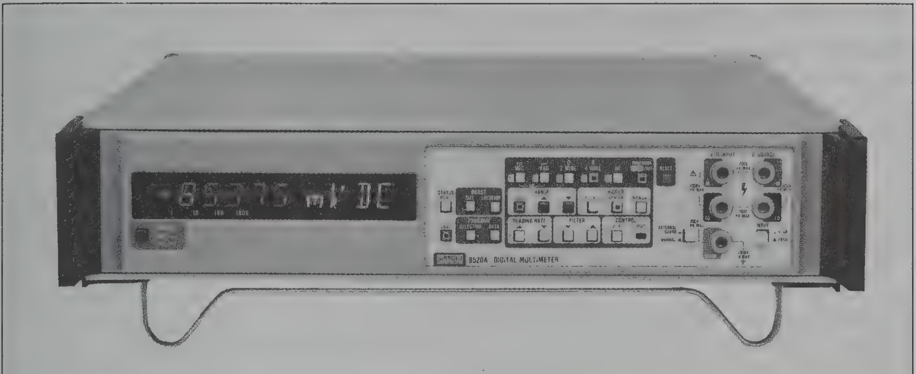
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-8506A Repair (w/calibration)	562
SC1-8506A Repair (cal w/in or out data)	637
SC1-8506A Repair (cal w/in & out data)	712
SC2-8506A Cal (1/yr recommended)	495
SC2-8506A Cal (1/yr w/in or out data)	570
SC2-8506A Cal (1/yr w/in & out data)	645
SC1-8505A Repair (w/calibration)	352
SC1-8505A Repair (cal w/in or out data)	427
SC1-8505A Repair (cal w/in & out data)	502
SC2-8505A Cal (1/yr recommended)	157
SC2-8505A Cal (1/yr w/in or out data)	232
SC2-8505A Cal (1/yr w/in & out data)	307

8520A, 8522A, 8520A/AS-1, 8520A/PRT

GPIB
IEEE-488



(NSN 6625-01-126-3154) **8520A**

Intelligent DMMs for Bench or System

- Dc and ac volts
- 2 and 4-wire ohms
- Conductance
- 520 readings per second
- 20 ppm basic dc accuracy
- Burst memory and math capabilities
- Standard system interfaces: 8520A GPIB/IEEE-488; 8522A: Parallel and BCD
- 8520A/AS-1 MATE certified DMM

The 8520A and 8522A are designed for system and bench applications and have built-in system interface circuits. The performance specifications of the two instruments are almost identical. The principal difference is that the 8520A has an interface compatible with GPIB/IEEE Std 488-1978* and the 8522A has an interface suitable for either BCD or Parallel (binary) applications.

The 8520A/AS-1 and the 8520A/PRT are unique variations of the 8520A. One, the 8520A/AS-1, is compatible with U.S. Government Modular Automatic Test Equipment (MATE) system. And the 8520A/PRT includes a Platinum Resistance Probe for extremely accurate temperature measurements.

Seven standard and seven optional math programs plus a built-in "burst" memory make these multimeters exceptionally intelligent stand-alone units. A choice of dc volts, true-rms ac volts, 2-wire or 4-wire ohms, and the Fluke exclusive conductance function make the instruments very versatile. The conductance function provides a simple way to measure resistance from 10 MΩ to 100,000 MΩ.

The instruments boast 50 ppm basic dc accuracy for 90 days with 5-1/2 digit resolution. A 520 readings-per-second system rate with 4-1/2 digits resolution is standard for high speed measurements. Or make 240 readings per second (with 60 Hz line operation) with 5-1/2 digits resolution. Inputs are switchable from front to rear too.

An unprecedented degree of prompting and operational cues are provided for skilled and unskilled technicians alike. A simple, uncluttered color-coded front panel makes operation easy.

Math Programs

Fourteen pre-programmed functions are available for the 8520A, 8520A/AS-1, 8520A/PRT, and 8522A. The first seven are standard; eight through fourteen are standard on the 8520A/AS-1 but optional on the other models. For systems use, these powerful programs will reduce software overhead greatly. They also simplify and speed testing for ordinary bench applications. Up to three math programs can be chained or stacked for simultaneous use.

The Standard Programs

1 = TEST. Four separate internal test programs do diagnostic checks on analog circuitry, digital hardware and software, and the front panel keys and displays.
2 = ZERO. Eliminates the effect of lead resistance for ohms tests and subtracts low-level dc components in the dc voltage function.
3 = XREF (external reference). Compares an unknown voltage at the front panel to a known rear-panel input. The display is the ratio of the front and rear inputs.
4 = OSR (offset/scale/ratio). Allows you to enter any constant in the formula (X = measurement *minus* offset *times* scale *divided* by ratio) from the keyboard, the memory, or a current reading.
5 Δ PCT (percent deviation). Compares all subsequent readings with a stored nominal value. The display appears as plus or minus a percentage deviation.
6 = PEAK. Constantly monitors the maximum and minimum readings. These values can be recalled as well as the "peak-to-peak" variation.
7 = LIM (limits). Turns the multimeter into a sorting machine. Inputs are sorted and displayed in three ways "High," "Pass" and "Low," based on previously stored upper and lower limits. You can recall the number of high, low, and pass readings, plus the total number of readings.

The Other Programs (Part of Option -010)

8 = STAT (statistics). Computes the mean, standard deviation, and variance of readings taken or data stored in memory registers.
9 = LFAC. A unique way to accurately measure low frequency ac signals from dc to 10 hertz.
10 = dB. Calculates dB, dBm or dBV of a measured value and displays dB.
11 = RTD. Implements equations which convert the resistance of a resistance temperature detector (RTD) to temperature in °C. Readouts in K or °F are also selectable.
12 = JVC (junction voltage Celsius). Computes °C, °F, or K based on inputs from a Fluke 80T-150C Temperature Probe (calibrated for °C).
13 = JVF (junction voltage Fahrenheit). For use with the Fluke 80T-150F (calibrated for °F). Performs the same operations as Program 12.
14 = THMS (thermistor linearization). Converts the resistance of a thermistor to temperature in °C, °F, or K.

Burst Memory (Reading Storage)

The unique burst memory lets you store up to 50 readings at any reading rate (400 readings with Option -010). In fact, the most recent 50 (or 400) readings are always stored in a shift register and available for recall and analysis whenever measurements cease. In the burst mode the storage operation may be independently triggered to capture a particular group of successive readings that may occur before, after, or both before and after the trigger instant. The storage of readings may be delayed after the trigger, as shown in example D, below.

Stored readings can be recalled individually or scanned in sequence for display on the front panel. Or they may be transferred to a controller or computer via the interfaces available in the 8520A or 8522A. Math processing can be applied to readings stored in memory as they are recalled.

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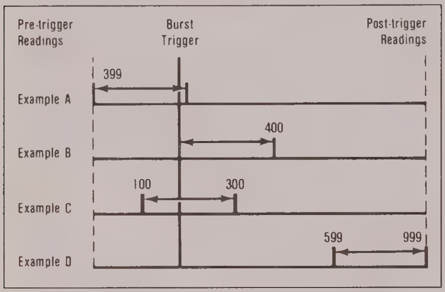
* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

8520A, 8522A, 8520A/AS-1, 8520A/PRT

Burst memory, (400 readings part of Option -010)



With Option -010, the burst memory may capture any group of 400 successive readings that occur within 399 readings prior to and 999 readings following the burst trigger. In example A, only one reading is taken after the trigger point. In example B, 400 readings immediately following the burst trigger are captured. Example C shows storage of 100 readings prior and 300 readings after the trigger point. The last example shows 400 readings being stored commencing 599 readings after the trigger.

8522A Parallel and BCD Interface

Speed and real-time measurement are key system elements available in the 8522A when the Parallel (binary) interface is selected. That interface offers both a three- and a four-wire handshake (switch-selectable) for use with the most popular parallel computer interfaces. A choice of *eight-* or *sixteen-* bit messages are selectable at the rear of the instrument.

The BCD interface emulates BCD remote operation of the Fluke 8375A and 8400A, for the convenience of customers who wish to replace these or any of a large variety of older DMMs in their system. Remote control and data output capabilities are the same as those of the 8375A and 8400A. All but the conductance function may be controlled remotely, plus the range filter and external reference.

Output of readings include five BCD digits, an overrange bit, an overload bit, polarity bit, and three coded range bits. Status output includes function, filter, external reference and remote/local.

8520A/AS-1 – for MATE Systems

The 8520A/AS-1 is equipped with a built-in interface interpreter which makes it compatible with Modular Automatic Test Equipment (MATE) systems. This capability allows a MATE Test Executive to operate the 8520A/AS-1 on the IEEE-488 bus using Control Interface Intermediate Logic (CIIL). It will operate in either the "CIIL Mode," responding only to CIIL commands or in the "native mode," responding to either CIIL commands or IEEE-488 bus commands. Data transmission is increased to 120,000 characters per second for direct memory access using the CIIL mode.

The 8520A/AS-1 was the first candidate module to become MATE certified.

8520A/PRT – Temperature Measurements

The 8520A/PRT is a temperature measurement system consisting of a Rosemount 162N Platinum Resistance Thermometer (PRT) and an 8520A containing a built-in linearization program customized to match the calibration curve of the specific PRT supplied. Temperature is indicated directly in either °C, °F or K with 0.001 degree resolution.

The 8520A/PRT provides a fast, low-cost way of making extremely accurate temperature measurements, or calibratin temperature measurement instruments, in the range of -200°C to +350°C. Systems using four-terminal resistance bridges are much more time-consuming to use, require greater expertise, are limited in their applications, and are far more costly.

Measurements are repeated approximately once per second, making it possible to detect and track fast temperature changes, something impractical to try to do with balance bridges.

See page 443 for more specifications.

Specifications

Technical Specifications

DC Voltage

Range	Full Scale	Resolution	Input Resistance
100 mV	199.999	1 µV	≥10,000 MΩ
1V	1.99999	10 µV	≥10,000 MΩ
10V	16.0100	100 µV	≥10,000 MΩ
100V	130.100	1 mV	10 MΩ
1000V	1024.00	10 mV	10 MΩ

Accuracy: ±(% of Input < Digits)

Range	24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient per °C*
100 mV	0.003+5	0.0065+6	0.011+10	0.0005+0.5
1V	0.003+1	0.006+2	0.011+2	0.0005+0.15
10V	0.002+1	0.005+1	0.009+1	0.0004+0.10
100V	0.003+1	0.007+2	0.012+2	0.0005+0.15
1000V	0.0035+1	0.0065+1	0.011+1	0.0005+0.10

**From 18°C to 0°C or 28°C to 50°C*

High Speed Accuracy: ±(% of Input + LS Bit)*

Range	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient Per °C
100 mV	0.01 + 1	0.015 + 1	0.001 + 0.1
1V-1000V			0.001 + 0.05

** Typical with 60 Hz line, remote operation, 500 readings per second, 2-byte binary output with 14 bits of data.*

Normal Mode Rejection

Line Freq	Filter Setting Time					
	25 ms	50 ms	100 ms	200 ms	500 ms	1s
50 Hz	65 dB	68 dB	71 dB	80 dB	83 dB	86 dB
60 Hz	65 dB	68 dB	71 dB	85 dB	88 dB	91 dB

Common Mode Rejection: True, 100 dB at 50 Hz and 60 Hz with 1 kΩ unbalance in either lead. Effective CMR is equal to normal mode rejection plus true CMR
Maximum Input: ±1000V peak, High to Low or Guard to chassis terminals, and ±200V peak, Guard to Low terminals, for any range
Bias Current: ≤50 pA

Maximum Reading Rate

Operation	Line	Rate	Resolution
Local Remote	50 Hz	200 rdgs/sec*	5-1/2 digits
	60 Hz	240 rdgs/sec*	
Remote	50 Hz 60 Hz	>500 rdgs/sec	4-1/2 digits

**For local operation, 8522A is limited to 1/2 this rate.*

AC Voltage (True RMS)

Input Characteristics

Range	Full Scale	Resolution	Input Resistance
1V	1.99999	10 µV	1 MΩ ≤100 pF
10V	16.0100	100 µV	
100V	130.100	1 mV	
650V	650.00	10 mV	

Accuracy: ±(% Input + % of Full Scale) ac or ac+dc*

Frequency	90 Days 18°C to 28°C			1 Year 18°C to 28°C		
	% of Input	+% FS AC	+% FS AC+ DC	% of of Input	+% FS AC	+% FS AC+ DC
10-20 Hz**	3.0	0.6	0.7	3.5	0.6	0.7
20-40 Hz**	0.5	0.5	0.6	0.6	0.6	0.7
40 Hz-20 kHz	0.1	0.03	0.08	0.15	0.05	0.16
20-100 kHz	1.0	0.3	0.4	2.0	0.6	0.8
100-300 kHz	2.4	0.6	0.6	4.0	0.1	0.1
300 kHz-1 MHz	8.0	2.5	2.5	15.0	5.0	5.0

**From 0.1% of range to full scale*
***With statistics program*

Temp. Coefficient: 18°C to 0°C or 28°C to 50°C, to 20 kHz

AC Mode: ±(0.007% of input + 0.007% FS)/°C
AC+DC Mode: ±(0.007% of input + 0.14% FS)/°C

Maximum Input: ±1000V peak High to Low or Guard to Chassic terminals, and ±200 V peak Guard to Low terminals
Crest Factor: ≥4:1 at full scale, increasing down scale
Maximum Reading Rate: 10 readings per second (rated accuracy, ≥400 Hz)

8520A, 8522A, 8520A/AS-1, 8520A/PRT

Maximum Slew Rate: 177V per µs
Maximum Volt-Hertz Product: 2 x 10^7

Resistance

Input Characteristics

Range	Full Scale	Resolution	Current Through Unknown	Open Circuit Voltage
10Ω 100Ω 1000Ω 10 kΩ	19.9999 199.999 1999.99 19.9999	100 µΩ 1 mΩ 10 mΩ 100 mΩ	10 mA 10 mA 1.0 mA 0.1 mA	7V
100 kΩ	199.999	1Ω	14.5 µA (max)	
1 MΩ	1.99999	10Ω	1.5 µA (max)	
10 MΩ	19.999	1kΩ	1.5 µA (max)	

Maximum Reading Rate

Operation	Line	Rate	Resolution
Local Remote	50 Hz	200 rdgs/sec*	5-1/2 digits
	60 Hz	240 rdgs/sec*	
Remote	50 Hz 60 Hz	>500 rdgs/sec	4-1/2 digits

**For local operation, 8522A is limited to 1/2 this rate.*

Accuracy: ±(% of Input < Digits)

Range	24 Hrs 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient per °C*
1Ω	0.0045+6	0.0080+7	0.0140+12	0.0007+2.0
100Ω	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
1000Ω	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
10 kΩ	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
100 kΩ	0.0040+2	0.0090+2	0.0140+3	0.0012+0.2
1 MΩ	0.0090+2	0.0160+2	0.0200+3	0.0020+0.2
10 MΩ	0.0300+1	0.0440+1	0.0450+3	0.0030+0.2

**From 18°C to 0°C or 28°C to 50°C*

Conductance

Range: 100 nS (10 MΩ)$^{-1}$
Full Scale: 199.99
Resolution: 0.01 nS (100,000 MΩ)$^{-1}$

Accuracy: ±(% of Input + Digits)

24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient Per °C*
0.4+5	0.05+5	0.06+5	0.004+1

**From 18°C to 0°C or 28°C to 50°C*

Maximum Input: ±400V peak
Maximum Reading Rate: 10 readings per second

External Reference

Operating Range: ±0.5V dc to ±33V dc as long as external reference Low terminal is within ±16.5V of input Low terminal
Input Impedance: 10,000 MΩ between external reference High or Low terminals and input Low terminal

Ratio Accuracy

X-Ref Voltage	Accuracy
16.5V to 33V	±(A + B + 20 ppm)
0.5V to 16.5V	±[A + B + (400 ppm ÷ | Vref |)]

Note: A = DC 10 volt range accuracy
B = Input voltage or resistance range accuracy

Maximum Input: ±180V peak between external reference High or Low and input Low; ±360V peak between externa reference High and Low

Transfer Accuracy

The following accuracy specifications apply when:

- Reading rate is 2 readings per second
- Filter settling time is 500 ms
- Warm-up is at least 2 hours
- Quantity measured has same nominal value and frequency as transfer standard
- Measurements are made in one range
- Standard is checked at least every hour
- Ambient temperature remains within ±1°C

DC Voltage

Range	±(% of Input + Digits)
100 mV	0.0020 + 4
1V	0.0020 + 1
10V	0.0010 + 1
100V	0.0020 + 1
1000V	0.0020 + 1

AC Voltage (all ranges)

Frequency	±(% of Input + % of Full Scale)
10 Hz to 20 Hz	1.0 + 0.2
20 Hz to 40 Hz	0.1 + 0.1
40 Hz to 20 kHz	0.005 + 0.009
20 kHz to 100 kHz	0.100 + 0.030
100 kHz to 1 MHz	0.500 + 0.60

Resistance

Range	±(% of Input + Digits)
10Ω	0.0030 + 5
100Ω	0.0020 + 2
1000Ω	0.0020 + 2
10 kΩ	0.0020 + 2
100 kΩ	0.0020 + 2
1 MΩ	0.0050 + 2
10 MΩ	0.0100 + 1

Conductance (100 nS Range): ±(0.02% of input + 0.02 nS)

General Specifications

IEEE-488 Interface: Standard in the 8520A, 8520A/AS-1 and 8520A/PRT
Parallel (Binary) and BCD Interface: Standard in 8522A

BCD Data Output: Standard 0V and +5V TTL levels positive true, 8-4-2-1 code. Five BCD digits with an overrange bit, overload, polarity, and three coded range bits. The output also includes the state of the instrument (function, filter, external reference, and remote or local).

BCD Remote Control: Standard TTL levels – Logic 1 equals +5V or open, Logic 0 equals 0V or contact closure. Controls all functions (except conductance), range, filter (fast, slow), and external reference. Continuous-command entry and triggered-command entry.

Parallel: In bit parallel operation all features and functions can be accessed through the remote interface. Maximum speed in this mode is 520 readings per second

Format: Select 8 or 16-bit message format with a rear panel switch

Handshake: Handshake configuration is also switch selectable 3- or 4-wire for compatibility with computers, mini-computers, and instrument controllers

Temperature: 0°C to 50°C, operating; -25°C to +75°C non-operatiing; for 8520A/AS1, non-operating temperature range is -40°C to +75°C
Altitude: 10,000 feet operating, 40,000 feet non-operating
Relative Humidity: ≤95% to 25°C, ≤75% to 40°C, ≤40% to 50°C
Shock & Vibration: Meets MIL-T-28800C for Type III, Class 5, Style E
Power: 100, 120, 220, or 240V ac, ±10%, 50 to 60 Hz, ≤50W
Size: 8.9 cm H x 45.7 cm L x 43.2 cm W (3-1/2 in H x 18 in L x 17 in W)
Weight: 9.56 kg (21 lb)
Included: Manual, power cord, rear panel mating connector for analog input, serialized and dated calibration certification sheet

8520A, 8522A, 8520A/AS-1, 8520A/PRT

Ordering Information

Models

January 1989 prices

8520A	DMM with IEEE-488 interface	$3350
8522A	DMM with BCD and Parallel Interface	5200
8520A/AS-1	DMM for MATE	4595
8520A/PRT	Temperature Measurement System	7350

Option (for 8520A & 8520A/PRT)*

-010	Extended Software Package	600

** Included with 8520A/AS-1 and 8522A. Factory or Service Center installation only.*

Accessories (Also see page 127)

Y9111	0.93m, 3 ft Trigger Cable	20
Y9112	1.85m, 6 ft Trigger Cable	20
Y8133	Universal Test Lead Set	22
Y2037	100Ω RTD Temperature Probe	260
Y8021	1m, IEEE-488 Shielded Cable	130
Y8022	2m, IEEE-488 Shielded Cable	145
Y8023	4m, IEEE-488 Shielded Cable	155
Y8597	Interface Adapter for 8375A, 8400A	250
Y8598	3-1/2" Rack Adapter with 22" slides	130
Y8599	3-1/2" Rack Adapter only	70

Conversion of 8520A/AS

Conversion of 8520A/AS to 8520A/AS-1 is available from your Fluke Service Center. Order 8520A/AS/AS1. The price of the conversion is $950.

Service & Support

Warranty

One-year product warranty. (See page 470 for further information on warranty terms and conditions.)

Extended Warranty

SC1-8520A	Repair (w/calibration)	$242
SC1-8520A	Repair (cal w/in or out data)	317
SC1-8520A	Repair (cal w/in and out data)	392
SC2-8520A	Cal (1/yr recommended)	126
SC2-8520A	Cal (1/yr w/in or out data)	201
SC2-8520A	Cal (1/yr w/in and out data)	276
SC1-8522A	Repair (w/calibration)	264
SC1-8522A	Repair (cal w/in or out data)	339
SC1-8522A	Repair (cal w/in and out data)	414
SC2-8522A	Cal (1/yr recommended)	126
SC2-8522A	Cal (1/yr w/in or out data)	201
SC2-8522A	Cal (1/yr w/in and out data)	276

PM 2534 & PM 2535

GPIB
IEEE-488

PM 2535

PM 2534 & PM 2535 System Multimeters

- 3-1/2 to 6-1/2 digits
- 100 nV resolution
- 100 measurements/s
- GPIB/IEEE-488 interface standard
- Front or rear input
- Scanner extension

The Philips PM 2534 and PM 2535 Systems Multimeters cover a broad range of applications. While both are suitable for a wide range of general purpose measurements, the PM 2535 offers additional advanced functions for applications demanding data gathering, and fast measurement collecting and processing.

Basic Features

Both the PM 2534 and PM 2535 offer seven measurement functions, front or rear inputs, and 6-1/2 digit guarded sensitive measurements or up to 3-1/2 digit high speed measurements. The units can operate in scan mode under external control via the standard GPIB/IEEE-488* interface.

Extra Capabilities of the PM 2535

As well as the above features, the PM 2535 has built-in data collection, advanced control facilities and calculations including Ax + B, Δ%, dBm and relative measurements. Maximum and minimum values can be stored over a time interval, and warnings can be given if specified limits are exceeded. Burst mode provides up to 150 measurements/sec. Sequence programming allows repetition of the same measurement cycle; thus, when combined with a System 21 module (page 380), allows the PM 2535 to act as a small data logger with no need for dedicated computer control.

Three Million Counts

Philips own VLSI technology is used in the custom analog-to-digital circuitry that gives the PM 2534 and PM 2535 their outstanding performance. The 100 nV resolution on a 300 mV measurement, plus its exceptional short-term stability (0.002%) and long-term accuracy (0.005%) more than substantiates this performance.

To guarantee this measurement integrity they are the only instruments in their class with a true, fully-guarded input. This eliminates parasistic lead voltages and noise which can be several orders of magnitude larger than the measurement resolution of the instrument itself and would otherwise invalidate sensitive measurements.

Fast Measurement and Output

At a touch of the 'speed' button, the PM 2534 and PM 2535 step through 6-1/2, 5-1/2, 4-1/2, and 3-1/2 digit modes, enabling the optimum speed/resolution combination to be selected for every application. At a 3-1/2 digit resolution the instrument makes 100 measurements per second and can transmit the measured values through its standard GPIB interface at the same rate.

This is achieved by the use of two powerful 8-bit microprocessors in parallel – one controlling measurements while the other controls the GPIB interface function. In addition, the measurement and interface functions are galvanically separated, eliminating the possibility of ground loops between different instruments connected to the bus, which can ruin sensitive measurements.

V_{DC} Measurement Speed (including Controller)

Digits	Trigger Mode	Measurements/s
3-1/2	Internal	100
3-1/2	IEEE	50
4-1/2	IEEE	30
5-1/2	IEEE	3
6-1/2	IEEE	0.3

Typical measurement speeds

Measurement Capabilities

The very high performance of these instruments covers more than DC voltages alone. Every aspect of performance including all DMM measuring functions, as well as temperature, are included as standard.

Function	Maximum Resolution	Maximum Range	Accuracy (90-Day)
V_{DC}	100 nV	300V	0.05%
V_{AC}	10 μV	300V	0.2%
I_{DC}	100 nA	3A	0.03%
I_{AC}	10 μA	3A	0.2%
Ω 2-wire	1 mΩ	300 MΩ	0.02%
Ω 4-wire	1 mΩ	3 MΩ	0.02%
°C via Pt-100	0.1°C	-100°C... +850°C	0.3%

Simple English Commands

PM 2534 and PM 2535 are without doubt two of today's friendliest programmable instruments, because they respond to simple English commands rather than complex codes. For example, to measure an unknown AC voltage, it is necessary only to enter the command 'VAC AUTO', and both the AC voltage and autoranging functions are immediately selected.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 2534 & PM 2535

To ensure faultless communication with both user and computer, these instruments also accept numeric ranging values in either decimal or exponential notation, and automatically round-off to the correct range. For example, the commands 'VDC-2' or 'VDC 185E-3' both result in selection of the 300 mV DC range. The PM 2534 and PM 2535 also overcome one major drawback of many other programmable instruments — the amount of 'string splitting' that the controller has to perform to extract the required measurement data. Use of the 'OUT' command gives exactly the required data, eliminating this complex and time-consuming task.

Command	Output string to controller
OUT String	'VDC + 123.4567 E-03'
OUT Numeric	'+ 123.4567 E-03'
OUT N, 6	'123.4'

For applications needing operator instructions, messages can be generated on the DMM display with the "TXT" command.

Operator and Application Friendly

Single button selection of function, range and trigger modes make the PM 2534 and PM 2535 very simple to use. Precise measurements are always made very quickly thanks to the 'NULL' key to compensate for small offsets and the 'FILTER' key to eliminate small instabilities on DC signals.

Access to the GPIB address and mode of operation is under the 'CHECK' function but to prevent unauthorized use in systems application this can be 'locked-out' resulting in a 100% tamper free front panel.

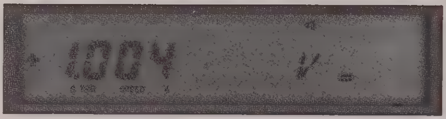
And emphasizing the system-oriented design even further, the standard facility for full electronic calibration allows simple recalibration either via the GPIB bus, or manually, without the need to open the case.

PM 2435 for Collection, Calculation and Control

As for the PM 2534, all the PM 2535's normal measuring functions are directly selectable by a single keystroke. When the calculation, collection or control facilities are required, a simple touch of the SHIFT key reveals a logical and extremely simple user prompting technique. Each key has two color-coded sublevels, with the active level clearly indicated on the display.

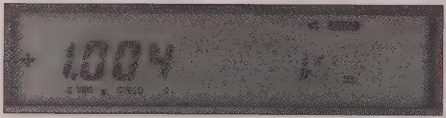
In addition, user prompting messages appear on the display to request the required user input. The example below shows how simple this facility is to use.

Once the required measuring set-up has been programmed, it can also be saved in one of ten non-volatile PROG memory locations, so that the next time it is needed it can simply be recalled by number, rather than having to be reprogrammed.



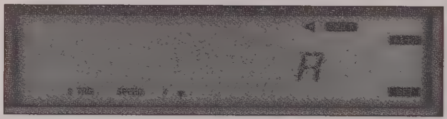
Normal measurement display

Press SHIFT



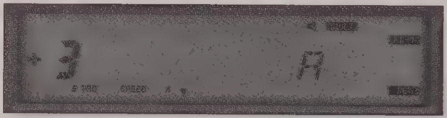
SHIFT appears on display

Press Ax x B



Ax x B and SET appear on display
Display requests setting of A

Press 3



New value of A defined

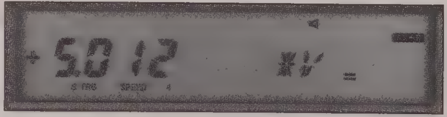
Press ENTER

New value of A entered
Display requests setting of B

Press 2

New value of B defined

Press ENTER



New value of B entered
PM 2535 now shows measuring
Results scaled according to 3x + 2 where x is the measured value

Direct Parameter Display

In many applications, the measured voltage or current is just a function of the real measured parameter, for example where pressure transducers are used. Translating the measured value into the parameter actually required would normally tie-up a computer, and require additional software to be written. The PM 2535 has this capability as standard, enabling the following transformations to be achieved:

Ax + B	For scaling for example transducer outputs with live zeros.
dBm	For direct amplifier gains and losses. The value of the reference resistance is user programmable.
Δ%	For % tolerance measurements for example when matching components. This uses the formula ((X - C) * 100) ÷ C.
ZERO	For absolute deviation measurements from a specified value which can be measured or programmed.
LIMITS	For fast and accurate GO/NO GO measurements within or outside a predetermined range.

Data Collection

At any time, the Minimum or Maximum measurement made in the selected measuring function can be checked by using the MIN/MAX key. The PM 2535 also has a 999-point buffer which is constantly active. This ensures that the last 999 measurements can be reviewed at any time, and ensures that measurements are not lost — you can always go back to them using the RD.BUF. key.

In applications requiring the collection of data following an event, rather than preceding it, the use of the BURST key relocates the internal buffer relative to the trigger point, so that the buffer then acts as a post-trigger memory. In combination with the DELAY facility, this mode enables a measurement to be made every five minutes, for example, over a three-and-a-half day period; ideal for weekend monitoring of test set-ups.

The internal buffer is also valuable when very fast measurements need to be made. One-for-one output of measured values via the GPIB bus can take place at up to 100 measurements/sec., depending on the controller's GPIB specification.

The PM 2535 can measure at up to 150 measurments/sec., and by storing these directly in the internal buffer, more than 6 seconds of high-speed measurements can be collected regardless of the controller's speed.

After such a measurement cycle, all or any selected part of the buffered information can be transmitted at the normal transfer speed of the computer.

Controlling System 21 Modules

Many system applications demand measurements to be made at a number of different points and require large and expensive scanners. But with the PM 2534 and PM 2535, System 21 can be added to any GPIB application to provide a modular and cost-effective solution to system switching. Both the PM 2534 and PM 2535 have a System 21 master unit built-in, enabling them to control the PM 2120 universal switches or the PM 2121 low level switches.

Specifications

Technical Specifications

Volts DC/Amps DC

Ranges	Maximum Resolution	Accuracy: 5-1/2 or 6-1/2 Digits in %Rdng + %Rng			Temp. Coeff./°C in %Rdng + %Rng	Input Characteristics
		24 Hrs (tcal ±1°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)		
30 mV	100 nV	0.0025 + 0.0014*	0.007 + 0.0017*	0.012 + 0.0017*	0.002 + 0.0005	10 MΩ//30 pF
3V	1 µV	0.0020 + 0.0010	0.005 + 0.0013	0.010 + 0.0013	0.002 + 0.0005	10 MΩ//30 pF
30V	10 µV	0.0025 + 0.0013	0.006 + 0.0017	0.015 + 0.0017	0.002 + 0.0005	10 MΩ//30 pF
300V	100 µV	0.0025 + 0.0010	0.006 + 0.0013	0.010 + 0.0013	0.002 + 0.0005	10 MΩ//30 pF
30 mA	100 nA	0.01 + 0.005	0.03 + 0.005	0.05 + 0.005	0.005 + 0.001	<250 mV drop
3A (<1A)	10 µA	0.01 + 0.005	0.03 + 0.005	0.05 + 0.005	0.005 + 0.001	<600 mV drop
3A (>1A)	10 µA	0.10 + 0.0	0.15 + 0.01	0.20 + 0.01	0.005 + 0.001	<600 mV drop

Valid when using "NULL"

Operation Modes Scale Length	Speed Measurements/Sec.	Series Mode Rejection		Common Mode Rejection*			Common Mode Voltage Influence in %Rng/Volt		
		50-60 Hz ±0.1%	50-60 Hz ±1.0%	DC	50-60 Hz ±0.1%	50-60 Hz ±1%	DC	50/60 Hz + 0.1%	50/60 Hz ±1%
3000000	0.3	>80 dB	>60 dB	>140 dB	>160 dB	>140 dB	—	—	—
300000	3.0	>70 dB	>50 dB	>140 dB	>150 dB	>130 dB	0.00002	0.00002	0.00002
30000	30	>60 dB	>40 dB	>140 dB	>140 dB	>120 dB	0.00002	0.00002	0.00002
3000	100 (150)**	—	—	>140 dB	>80 dB	>80 dB	0.002	0.01	0.01

**Measured with 1 kohm unbalance and guard connected to CM voltage* ***For PM 2535 using internal buffer*

Maximum Input Voltage: 600V peak, 300V continuous
Maximum S.M. Voltage: 140% of selected range
Maximum C.M. Voltage: 350V peak between low and guard; 350V peak between guard and ground

Filters: User-selectable digital
Clip Indication: † is displayed when input circuitry clips during measuring cycle
Null Range: ±100 µV
Protection: 3.15A fuse

Volts AC RMS/AC Amps

Ranges	Maximum Resolution	Input Characteristics	Accuracy: 4-1/2 or 3-1/2 digits in %Rdng + %Rng valid from 1% to 100% of range			
			Frequency Range	24 Hrs (tcal ±5°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)
300 mV 3V	10 µV 100 µV	1.2 MΩ//30 pF	40/400 Hz - 5 kHz	0.10 + 0.10	0.20 + 0.10	0.30 + 0.10
30V 300V	1 mV 10 mV	0.93 MΩ//30 pF	5 kHz-100 kHz per kHz	0.02 + 0.02	0.04 + 0.02	0.06 + 0.02
30 mA	1 µA	<250 mV drop	*40/400 Hz - 1 kHz	0.1 + 0.1	0.2 + 0.10	0.3 + 0.10
3A	100 µA	<600 mV drop	*40/400 Hz - 1 kHz	0.1 + 0.1	0.2 + 0.10	0.3 + 0.1

**Analog Filter on/off*

Operation Modes Scale Length	Speed Measurements/Sec
30000	2.5
3000	25

Protection: 3.15A fuse
Crest Factor: 3.3 at full scale, increasing down scale. Crest factor overload indicated by 1 on display
Temperature Coefficient: <0.03%/°C

Maximum Volt-Hertz Product: 10^7
CMRR: With 1 kΩ unbalance and guard to '0': >120 db for DC signals; >80 db for 50 /60 Hz AC signals
Maximum Input Voltage: 600V peak, 400V continuous

PM 2534 & PM 2535

Ohms (2-Wire and 4-Wire)

Ranges	Maximum Resolution	Accuracy 6-1/2 or 5-1/2 Digits in % Reading + % Range			Input Characteristics (Non-Linear)
		24 Hr (tcal ±1°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)	
3 kΩ	1 mΩ	0.010 + 0.0033	0.02 + 0.0033	0.03 + 0.0033	1 mA drive
30 kΩ	10 mΩ				100 µA drive
300 kΩ	100 mΩ				10 µA drive
3 MΩ	1Ω	0.020 + 0.0033	0.04 + 0.0033	0.05 + 0.0033	1 µA drive
30 MΩ*	100Ω	0.060 + 0.0033	0.10 + 0.0033	0.15 + 0.0033	100 nA drive
300 MΩ*	10 kΩ	0.8 + 0.033	1.6 + 0.033	2.0 + 0.033	10 nA drive

**Only in 2 wire configuration*

Operation Modes Scale Length	Speed Measurements/Sec
3000000	0.25
300000	2.5
30000	25
3000*	65

**Excluding 3 MΩ, 30 MΩ and 300 MΩ ranges*

Maximum Open Circuit Voltage: 10V
Maximum 4-Wire Lead Resistance: 100Ω
Protection 2-Wire Terminals: 250V ac or dc, 350V peak
Protection 4-Wire Terminals: 30V ac or dc, 42V peak
Maximum CM Voltage: 2-Wire: 250V ac or dc, 350V peak between '0' and guard, or between guard and ground; 4-Wire: 30V ac or dc, 42V peak between '0' and ground; guard must be connected to '0'
Linearization: According to DIN 43760
Max Voltage: Between '0' and guard 30V ac or dc, 42V peak

General Specifications

Power Supply: 115V or 230V (±10%)
Line Frequency: 50 Hz or 60 Hz (±1%)
Power Consumption: 20 VA
Safety Class: IEC 348 class I
Dimensions: 280 x 210 x 86 mm (11 x 8.3 x 3.4 in.)
Weight: 2.9 kg (6.2 lbs)
MTBF: 32 000 hrs
Calibration Interval: 1 year
Included with the instrument: Set of safety test leads with probes, spare fuses, operating instructions, service manual

Temperature (via Pt 100 R to probe)*

Meter Ranges	Resolution	Accuracy	Measurements/Sec
-100 to 850°C	1.0°	0.3% Reading + 0.2°C	30
-100 to +850°C	0.1°C	0.3% Reading + 0.2°C	3

**For optional accuracy see PM 9249/01 RTD Probe*

Environmental Conditions

Reference Temperature: 23°C ±1°C
Rated Range of Use: 0...+50°C
Operating Range: 0...+55°C
Storage and Transport: -25...+70°C
Limits of Humidity for Operation: 20...80%
Max Dew Point: +25°C
Included: Set of safety test leads (PM 9266/02), Operating manual, Service manual

Ordering Information

Models

January 1989 prices

PM 2534/013 Standard Instrument	$1095
PM 2535/013 Standard Instrument	1395

Note: The above configurations meet North American power requirements. For other power options, see page 491.

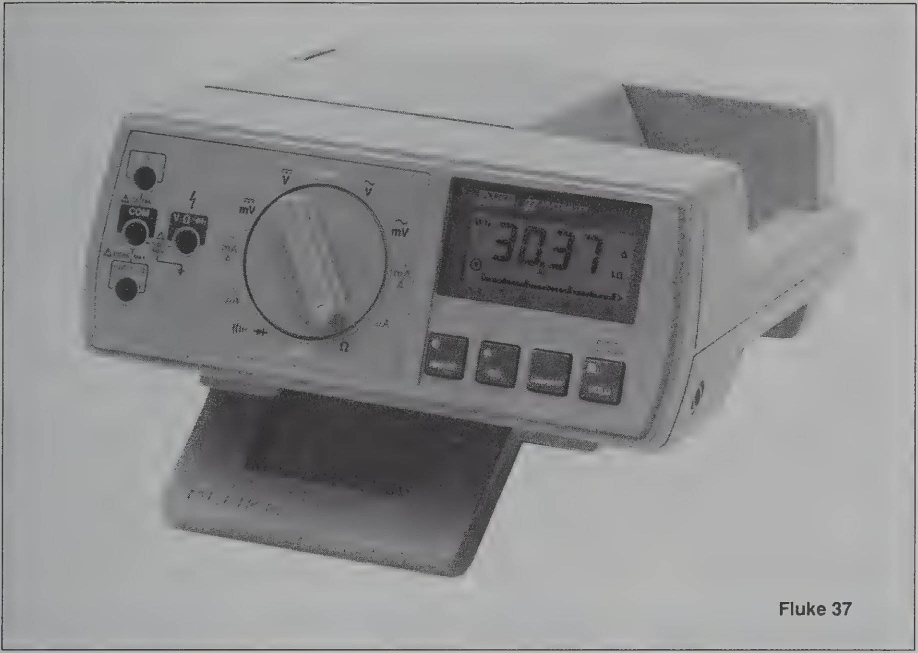
Accessories (Also see page 127)

PM 2193/01 System 21/PM 2534/ PM 2535 Rackmount Adapter	$235
PM 9266/02 Set of Test Leads with Probes, spare fuses	150
PM 9210/00 High Frequency 150 mV Probe 10 kHz ...1 GHz	259
PM 9213 High Frequency 10 mV Probe 10 kHz ...100 MHz	69
PM 9244 AC and DC Current Shunt up to 31.6A	69
PM 9245 AC Current Transformer 10A...150A	65
PM 9246/03 High Tension Probe	149
PM 9249/01 Temperature Probe	150
PM 9264/01 4-wire Test Lead for resistor measurement	85
PM 9265/01 Shielded 3-wire Test Lead	110
PM 9280/02 19-in Rackmount Adapter (3E/132 mm/5.22-in)	175
HM 9606/00 Rackmount Kit for the PM 2534/35 & PM 6660 Family of Counters	95

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.



Fluke 37

Fluke 37 Bench Portable Digital Multimeter
Sloped front panel for easy viewing
3200-count digital display, combined with fast 31-segment analog bar graph
"Min-Max" and "Relative" modes
Fast autoranging and Touch Hold® functions
0.1% basic dc accuracy, overload protection to 1000V rms, fused 10A range
Built-in storage compartment for accessories and a detachable tilt stand
Superior shielding against electromagnetic interference (EMI)
Survives 6 kV transients on 660V major ac feeders
Designed to meet UL 1244 requirements

Unique Case Design

The internal design of the Fluke 37 allows the front panel to slope 15 degrees, permitting easy viewing from a number of operating positions. When used in the flat position the Fluke 37 may be stacked with other instruments.

Storage Compartment/ Carrying Handle

A storage compartment for test leads and small accessories is built into the case. Access to the battery and fuses is through a snap-out door inside this compartment. A built-in carrying handle (molded into the case) offers portability when needed.

High Performance

0.1% basic dc accuracy, low millivolt to 1000V ac and dc voltage measurements, 30 kHz ac response, low microamp to 10A ac and dc current measurements, low milliohms to 32 MΩ resistance, up to 10,000 MΩ with conductance.

3200-Count Digital Display

Better accuracy and resolution than a conventional 3-1/2 digit (2000 count) DMM, High contrast liquid crystal display with a wide viewing angle, updated two times per second.

31-Segment Analog Bar Graph

Makes dynamic indications such as peaking, nulling, zero adjustments and capacitor checking. Updates ten times faster than digital readout.

Min-Max & Relative Modes

Min-Max stores the highest and lowest digital reading, allowing a signal to be monitored for seconds, or days. The Relative mode remembers a reading and shows the change (difference) between it and any following readings.

Fast Autoranging

Simplifies and speeds up the use of the meter by instantly selecting the proper range. Selectable manual ranging included.

Touch Hold®

The meter will beep, capture a measurement, and lock it on the digital display until you're ready to view it. Automatically updates with each new stable measurement if preferred for later viewing.

Audible Continuity/Diode Test

Wiring, diode and transistor checks can be done quickly without looking at the display. Easy to hear, mid-frequency beeper (1500 Hz).

EMI Shielding

A unique condutive shield fully encloses all circuitry to provide exceptional protection against electromagnetic interference.

Safety Designed

Extensive overload protection, high energy fuses, fused 10A range, non-metallic case and tilt-stand. All voltage inputs meet the power line surge tests for major feeders as defined in IEEE-587-1980, Category B, which includes simulated lightning and load switching transient pulses up to 6kV superimposed on 660V power lines.

Power

The Fluke 37 is battery powered for true portability. It is also equipped with an input jack which accepts the optional Fluke A81 battery eliminator accessory for continuous operation from line voltage. Typical battery life 1,000 hours.

Standard Equipment

Every meter is packaged with a pair of safety-designed TL70 right-angle test leads, spare fuse, 9 volt battery, and operator's manual.

37

Specifications

Technical Specifications

Basic electrical specifications are defined for the temperature range of 18° C to 28° C for one year after calibration. Accuracy is specified as within ±(% of reading plus number of least significant digits).

DC Voltage

Range	Resolution	Accuracy
320.0 mV	100 µV	0.1% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ nominal
Normal Mode Rejection Ratio: >60 dB at 50 and 60 Hz
Common Mode Rejection Ratio: >120 dB at dc, 50 Hz and 60 Hz; ≤1KΩ unbalance
Overload Protection: 1000V rms; 500V rms on 320 mV range
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Resolution	Accuracy		
		40 Hz- 2 kHz	2 kHz- 10 kHz	10 kHz - 30 kHz
320.0 mV	100 µV	0.5%+3	2%+3	4%+10
3.200V	1 mV			
32.00V	10 mV			
320.00V	100 mV			
1000V	1V	1%+3	3%+3	Not Spec

Extended Frequency Response: Typical -3 dB @ 100 kHz
Conversion Type: AC coupled, average sensing, calibrated to read the rms value of a sinewave
Input Impedance: 10 MΩ nominal, <100 pF
Common Mode Rejection Ratio: >60 dB, dc to 60 Hz, ≤1 KΩ unbalance
Overload Protection: 10^7 Volt-Hertz maximum, 1000V, 500V on 320 mV range
Response Time: ≤2s to rated accuracy

DC & AC Current

Range	Resolution	Nominal Burden Voltage
320.0 µA	0.1 µA	0.5 mV/µA
3200 µA	1 µA	0.5 mV/µA
32.00 mA	10 µA	5.6 mV/mA
320.0 mA	100 µA	5.6 mV/mA
10.00A	10 mA	50 mV/A

DC Accuracy: Within 0.75% + 2
AC Accuracy: Within 1.5% + 2 (40 Hz to 1 kHz)

Overload Protection
10A Range: 15A/600 fuse, 100,000A interrupt rating
mA Range/µA Ranges: 630 mA/250V fuse, 1500A interrupt rating; in series with a 2A/600V fuse, 10,000A interrupt rating
Response Time: ≤2s to rated accuracy

Ohms

Range	Resolution	Accuracy
320.0	0.1Ω	0.3% + 2
3.200K	1Ω	0.2% + 1
32.00K	10Ω	
320.0K	100Ω	
3.200M	1 kΩ	
32.00M	10 kΩ	1% + 1
32.00 nS	0.01 nS	2% + 10

Overload Protection: 500V rms
Test Voltage: <420 mV dc full scale up to 3.2 MΩ; >1.3V up to 32 MΩ. <2.8 V open circuit
Test Current: <1 mA
Response Time: ≤6s to rated accuracy in highest and lowest range; ≤2s for other ranges

Diode Test & Continuity

Diode Test Indication: Displays voltage drop; 0.5 mA nominal test current at 0.6V; 2.0V full scale. Momentary tone for test voltage dropping below 0.7V (typical silicon diode threshold).
Continuity Indication: Continuous audible tone for test resistance below approximately 150Ω
Open Circuit Test Voltage: <3.3V
Overload Protection: 500V rms

General Specifications

Storage Temperature: -55°C to 85°C
Operating Temperature: -15°C to 55°. Operate to -40°C for 20 minutes when taken from a 20°C environment 0°C to 50°C
Temperature Coefficient: 0.1 x the applicable accuracy specification per °C(<18°C or >28°C)
Relative Humidity: ≤90% (≤80% in 32 MΩ range) to 35°C, ≤70% to 50°C
Shock & Vibration: Per MIL-T-28800, Class 3
Electro-Magnetic Interference (EMI): MIL-STD-461 for RS03 (radiated susceptibility to 1V/meter from 14 kHz to 1 GHz) and RE02 (radiated emissions)
MIN/MAX Mode: Records digital display readings (updated twice per sec.)
Digital Display: 3200 counts plus polarity indication updated 2 times per second
Analog Display: 31 segment bar graph plus polarity indication, updated 25 times per second
Maximum voltage to be applied to any terminal: 1000V with respect to earth ground
Battery: 9V NEDA 1604. Symbol when 60 hours remain. 1000 hour typical

Safety: Protection Class II per IEC 348 and ANSI C39.5
Size: 97 mm H x 216 mm W x 231 mm L (3.8 in H x 8.5 in W x 9.1 in L)
Weight: 1.31 kg (2.9 lb)
Included: TL70 test leads, spare fuse, battery and instruction manual

Ordering Information

Model

January 1989 prices

Fluke **37** Multimeter	$249

Accessories (Also see page 127)

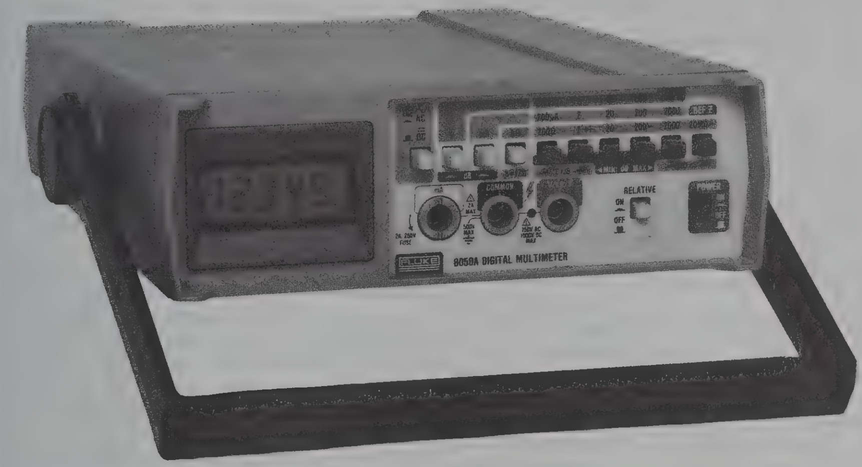
TL 20 Test Lead Set	35
Y8134 Deluxe Test Lead Set	22
Y8140 Test Lead Set	20
A81 Battery Eliminator	20
83RF High Frequency Probe	55
85RF High Frequency Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
80K-6 High Voltage Probe	49
80K-40 High Voltage Probe	85
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400 AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600 AC Current Probe	119
80i-1010 DC/AC Current Probe	229
80i-kW Current/Power Probe	395
LCA-10 Line Current Test Adapter	13

Service & Support

Warranty

Two-year product warranty. See page 470 for further information on warranty terms and conditions.

8050A



(NSN 6625-01-2141) **8050A**

8050A, High Performance Value

- 4-1/2 digits (20,000 counts)
- Nine functions including-Relative reference, dB, Conductance, Diode test
- 0.03% basic dc accuracy
- True-rms from 20 Hz to 50 kHz
- Microcomputer-based
- Extensive overload protection
- Rechargeable battery version available (-01)
- Touch-hold probe available (80T-H)
- Probes for rf, high voltage, high current available
- Factory Mutual approved

The 8050A provides superior performance and measurement capabilities in a low-cost, benchtop instrument. This 4-1/2-digit DMM has the following measurement functions: Dc volts, true-rms ac volts, dc amps, true-rms ac amps, ohms, dBm (with selectable reference impedances) conductance, and diode test. It also has a relative-reference feature that works with all measurement functions.

Relative Reference

When the RELATIVE switch is on, the displayed value is equal to the difference between the present input value and a previously stored reference value.

One application is to null out test lead resistance. The resistance of the test leads is first measured and stored in the 8050A. Subsequently, all displayed values of resistance will be actual values since the stored value of lead resistance will be automatically subtracted. Measurement errors are greatly reduced for low values of resistance (about 1Ω or less).

Another application is measuring the dB gain of the various stages of an audio amplifier. First, the input voltage to the amplifier is measured and stored as the zero dB reference value. Subsequent measurements will show the gain of each stage of amplification. Calculations are not needed; the 8050's microcomputer does it for you.

The relative-reference feature can be used to determine the drift of power supplies, the bandwidth or bandpass of audio devices, and lowpass filter response. This feature makes the 8050A an excellent pass-fail tester for the production line or incoming inspection.

dB Function

While many analog meters will indicate dBm referenced to 600 ohms, the 8050A provides digital read-out of decibels referenced to any one of sixteen impedances from 8 ohms to 1200 ohms. Now there is no need to use manual conversion tables—the internal microprocessor does the calculations for you. A front panel pushbutton and scrolling memory lets you select the reference impedance needed.

A resolution of 0.01 dB (above 1 mV) and high accuracy from 20 Hz to 50 kHz make the 8050A an extremely valuable tool for audio measurements. It can be used to determine the bandwidth of audio amplifiers, filters, audio consoles, etc. With the addition of an optional rf probe, the 8050A can be used on rf communications equipment.

Conductance

Two ranges of conductance extend the resistance-measuring capabilities of the 8050A to 100,000 MΩ, far beyond the capacity of ordinary multimeters. This lets you measure leakage of diodes, pcbs, cables, insulators, even measure transistor beta using a simple test adapter.

True-RMS AC

The 8050A uses a true-rms conversion technique to assure accurate measurement of non-sinusoidal waveforms as well as pure sinewaves. Examples: distorted or modulated sinewaves, squarewaves, sawtooths, noise, and pulse trains with a duty cycle of 10% of higher. Specified accuracy extends from 20 Hz to 50 kHz. Useful measurements go to 200 kHz, the typical -3 dB bandwidth.

Optional Touch-Hold Probe

The 80T-H Probe allows you to "hold" any displayed reading of voltage, resistance, or conductance as long as the control switch on the probe body is depressed. (Not for current or dB measurements.)

Overload Protection

The 8050A has extensive protection against overloads and operator errors. The instrument will accept up to 750V ac or 1000V dc continuously, regardless of the voltage range, or 500V dc when measuring resistance. It will also withstand short-duration transients to 6 kV.

The current input is protected against overloads by a 2A/250V fuse. For accidental connection of high voltage to the current input terminals (such as 480V ac line power) a heavy duty 3A/600V fuse backs up the first fuse.

Optional Accessories

Fluke offers a complete line of optional accessories that enable you to measure rf voltages to 500 MHz, temperature to 1000°C, current to 1000A, or high voltage to 40kV.

8050A

Specifications

Technical Specifications

All accuracy specifications apply for one year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of 90% or less.

DC Voltage*

Ranges: ±200 mV, ±2V,±20V, ±200V & ±1000V
Resolution: 10 µV on lowest range, 0.1V on 1000V range
Accuracy: ±(0.03% of reading + 2 digits) all ranges
Input Impedance: 10MΩ, ≤100 pF, all ranges
Normal Mode Noise Rejection: ≥60 dB at 50 Hz or 60 Hz
Common Mode Noise Rejection: ≥90 dB at dc, 50 Hz and 60 Hz with 1 kΩ unbalance
Overload Protection: 1000V dc or peak ac, continuous, except 10 seconds maximum on the 200 mV and 2V ranges
Response Time: 1 second maximum, to rated accuracy within a range

** DC voltage can also be measured using the dB mode with 0.01 dB resolution between 5% of range and full range*

AC Voltage (True-RMS, AC Coupled)

Voltage Readout: From 5% to 100% of range

Range	Resolution	Accuracy: ±(% of Rdg+Digits)					
		20 Hz*	45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
200 mV	10 µV	1% +10	0.5% +10		1% +10	5% +30	
2V	100 µV						
20V	1 mV						
200V	10 mV						
750V	100 mV		Not specified				

**Typically 3 to 5 digits of "rattle" will be observed at 20 Hz at full scale*

dB Readout: From 5% to 100% of range

Input Voltage	dBm 600Ω Ref	Range	Accuracy					
			20 Hz	45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
0.77mV -2mV	-60 to -52	200 mV*	±0.5 dBm				N/S	
2mV -2V	-52 to +8							
0.1V -2V	-18 to +8	2V*	±0.25 dBm	±0.15 dBm		±0.25 dBm	±0.75 dBm	
1V- 20V	+2 to +28	20V						
10V- 200V	+22 to +48	200V						
100V- 750V	+42 to +60	750V			Not specified (N/S)			

** When 200 mV range is selected, 8050A autoranges for best accuracy for inputs up to 2V*

dB Resolution: ±0.01 dB from 5% to 100% of range; 0.1 dB from 1% to 5% of range; 1.0 dB below 1% of range
Decibel Reference Impedances: Fifteen user-selectable impedance reference levels are provided to reference a 0 dBm, 1 mW level (50Ω, 75Ω, 93Ω, 110Ω, 125Ω, 135Ω, 150Ω, 250Ω, 300Ω, 500Ω, 600Ω, 800Ω, 900Ω, 1000Ω, 1200Ω. An 8Ω impedance reference level is provided to reference 0 dBW. (dBV = 1000Ω)
Input Impedance: 10 MΩ, ≤100 pF, all ranges
Extended dB Response: Typically -72 dBm (600Ω ref) ±1 dB to 10 kHz
Useful Frequency Range: Typically -3 dB at 200 kHz
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Common Mode Noise Rejection: 90 dB at 50 Hz and 60 Hz with 1kΩ unbalance
Overload Protection: 750V rms or 1000V peak continuous, except 10 seconds maximum on the 200 mV and 2V ranges, not to exceed a volt-hertz product of 10^7 (e.g., 200V at 50 kHz)
Response Time: 2 seconds max to rated accuracy within a range

DC Current

Range	Resolution	Accuracy: (5% to 100% of Range	Burden Voltage
200 µA 2 mA 20 mA 200 mA	10 nA 100 nA 1 µA 10 µA	±(0.3% of rdg + 2 digits)	0.3V max
2000 mA	100 µA		0.9V max

Overload Protection: 2A/250V and 3A/600V fuses in series

AC Current (True-RMS, AC Coupled)

Range	Resolution	Accuracy: ±(% of Reading + Digits)*				
		20 Hz**	45 Hz	2 kHz	10 kHz	20 kHz
200 µA	10 nA	2% + 10	1% + 10		2% + 10	
2 mA	100 nA					
20 mA	1 µA					
200 mA	10 µA					
2000 mA	100 µA				Not spec'd	

**Accuracy applies from 5% to 100% of range*
***Typically 3 t o 5 digits of "rattle" will be observed at 20 Hz at full range*

Burden Voltage: 0.3V rms max, 200 µA through 200 mA range; 0.9V max on 2000 mA range
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Overload Protection: 2A/250V and 3A/600V fuse in series

Resistance

Range	Resolution	Accuracy	Full Scale* Voltage
200Ω 2 kΩ*	0.01Ω 0.1Ω	±(0.1% reading +2 digits+0.02Ω)	0.19V 1.2V
20 kΩ 200 kΩ*	1Ω 10Ω	±(0.05% reading +2 digits)	0.2V 2V
2000 kΩ 20 MΩ*	199Ω 1 kΩ	±(0.25% reading +3 digits)	0.2V 2V

**Diode Test ranges*

Diode Test: The three diode test ranges are marked with a diode symbol and have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with the larger diode symbol. The three non-diode test ranges will not turn on silicon junctions when making in-circuit resistance measurements
Open Circuit Voltage: Less than 3.5V on all ranges
Input Protection: 500V dc or rms ac on all ranges
Response Time: (To rated accuracy) 10 seconds maximum on 20 MΩ range, 2 seconds maximum on all other ranges

Conductance

Range	Resolution	Accuracy
2 mS	0.1 µS	±(0.1% of reading + 5 digits)
200 nS	0.01 nS	±(0.5% of reading + 20 digits)

Equivalent Resistance
2 mS Range: 500Ω to 10 MΩ
200 nS Range: 5 MΩ to 100,000 MΩ
Open Circuit Voltage: Less than 3.5V on both ranges
Input Protection: 500V dc or rms ac on all ranges

Relative Reference

An input applied when the RELATIVE button is depressed is held as "0" reference point. Subsequent readings indicate deviations ± from this point.
Accuracy: Error will not exceed the sum of the errors for the two measurements.

General Specifications

Common Mode Voltage: 500V dc or peak ac max
Temperature: 0°C to 50°C, operating; -40°C to +70°C non-operating, except -40°C to +50°C with batteries
Temperature Coefficient: ≤0.1 times the applicable accuracy specification per °C from 18°C to 0°C and from 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤90% to 35°C, except 2000 kΩ, 20MΩ, and 200 nS ranges where it is <80% to 35°C
Safety: IEC 348, Protection Çlass I when operated from supply mains or Protection Class II when operated from internal batteries. Factory Mutual 3820 Approved. CSA 556A Certified.
Power: 90 to 110V ac, 105 or 132V ac, or 200 to 264V ac, 47 to 440 Hz, factory-configured for customer-specified voltage. With rechargeable battery version (-01), the line voltage range is field-changeable. 4W max, 6W with -01 version.
Batteries: NiCd batteries are installed in version -01. They provide 10 hours of typical operation on a full charge. Recharge takes 14 hours. Can run on ac line while charging
Size: 22 cm W x 6 cm H x 25 cm L (8.5 in W x 2.5 in H x 10 in L)
Weight: 1.08 kg (2.38 lb) for standard model
Included: Manual, line cord, test leads (TL70) and statement of calibration practice

Ordering Information

Models

	January 1989 prices
8050A DMM	$429
8050-01 DMM w/rechargeable batteries	469

Accessories (Also see page 127)

TL20 Test Lead Set	35
TL70 Test Lead Set	8
Y8132 Replacement Test Leads	11
Y8134 Deluxe Test Lead Set	22
Y8140 Slim Test Leads, w/needle points	20
C86 Ruggedized Carrying Case	20
Y8205 Carrying Case w/shoulder strap	35
80T-H Touch Hold Probe	59
83RF 100 MHz RF Probe	55
85RF 500 MHz RF Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
80K-6 High Voltage Probe	49
80K-40 High Voltage Probe	85
80J-10 Current Shunt	35
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400 AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600 AC Current Probe	119
80i-1010 DC/AC Current Probe	229
80i-kW Current/Power Probe	398
M00-200-611 3-1/2" Rack Adapter, Offset	50
M00-200-612 3-1/2" Rack Adapter, Center	50
M00-200-613 3-1/2" Rack Adapter, Dual	60

Service & Support

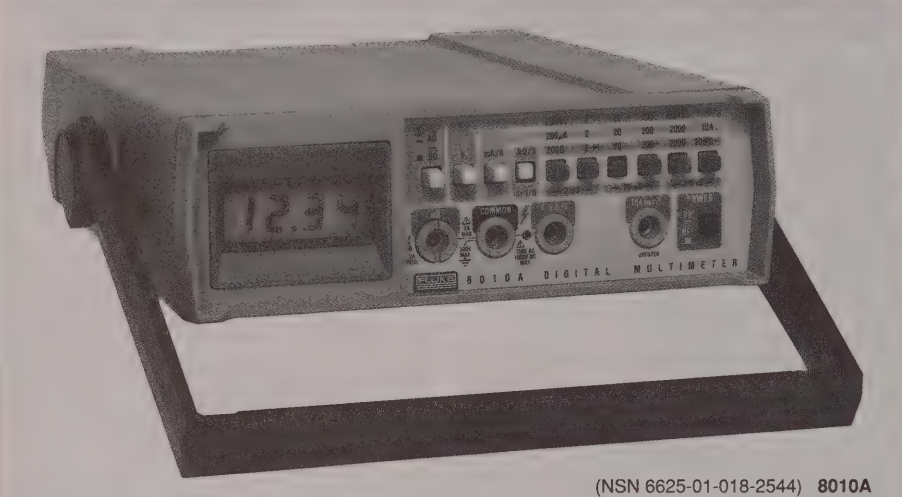
Warranty

One-year product warranty. (See page 470 for further information on warranty terms and conditions.)

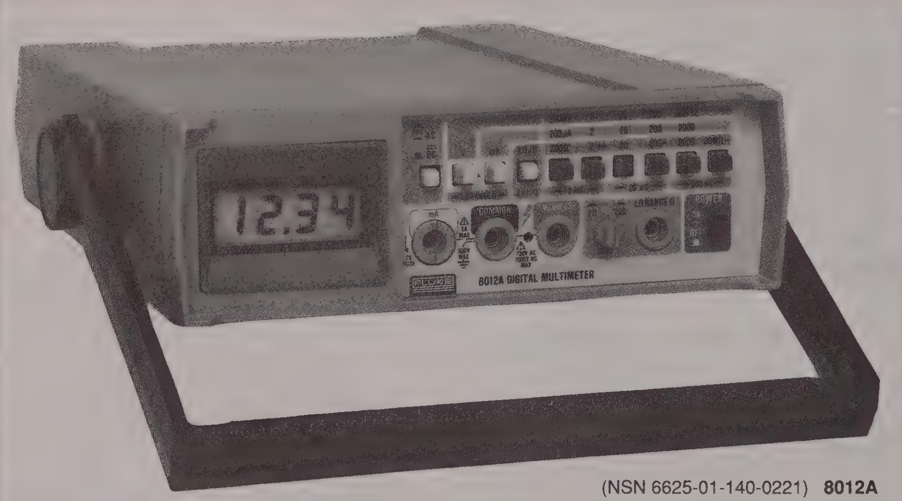
Extended Warranty

SC1-8050A Repair (w/calibration)	$47
SC1-8050A Repair (cal w/in or out data)	82
SC1-8050A Repair (cal w/in and out data)	117
SC2-8050A Cal (1/yr recommended)	35
SC2-8050A Cal (1/yr w/in or out data)	70
SC2-8050A Cal (1/yr w/in and out data)	105
SC1-8050A-01 Repair (w/calibration)	50
SC1-8050A-01 Repair (cal w/in or out data)	85
SC1-8050A-01 Repair (cal w/in & out data)	120
SC2-8050A-01 Cal (1/yr recommended)	35
SC2-8050A-01 Cal (1/yr w/in or out data)	70
SC2-8050A-01 Cal (1/yr w/in and out data)	105

8010A & 8012A



(NSN 6625-01-018-2544) **8010A**



(NSN 6625-01-140-0221) **8012A**

8010A & 8012A
3-1/2 digits (2000 counts)
Seven functions, including – Conductance, Diode Test
0.1% basic dc accuracy
True-rms ac, from 45 Hz to 50 kHz
10A range (8010A only)
2Ω and 20Ω range (8012A only)
Optional touch-hold probe (80T-H)
Extensive overload protection
Rechargeable-battery model (-01)
Extended measurements with optional accessories
Factory Mutual approved

The 8010A and 8012A are 3-1/2 digit portable/bench DMMs, that offer exceptional performance and features at a low cost. Measurement functions include: dc Volts, true-rms ac Volts, dc amps, true-rms ac amps, ohms, conductance, and diode test. The difference is that only the 8012A features two low-resistance ranges (2 ohms and 20 ohms) and only the 8010A features a 10A current range. Rechargeable-battery versions are available as Models 8010A-01 and 8012A-01. The 8010A and 8012A operate on ac line power only.

True-RMS

A Fluke-manufactured true-rms converter assures accurate measurements of non-sinusoidal voltage or current waveforms such as squarewaves (crest factor of 1 to 1). This custom hybrid provides low noise and a wide bandwidth. Accuracy is specified to 50 kHz, but the typical -3 dB bandwidth is 200 kHz.

Conductance

This unique and highly useful function makes resistance measurements as high as 10,000 M ohm possible. Since conductance, which is expressed in Siemens (S), is the inverse of ohms (1/Ω), a simple conversion of the DMMs conductance reading yields resistance. The conductance function is useful for checking high value resistors, leakage in connectors, cables, printed circuit boards, diodes, photodiodes, etc. Even the beta of a transistor may be measured using a simple adapter.

10A Range (8010A Only)

The 8010A has a 10 ampere ac or dc current range for applications that require measuring more than 2 amperes.

Low Ohms (8012A Only)

The 8012A has two additional ranges of low resistance—2 ohms and 20 ohms. Along with the conductance function, that gives you a resistance range of 0.001Ω to 10,000MΩ! There are not many resistance measurements that the 8012A can't handle.

The two low-resistance ranges are suited for measuring transformer windings, cables, heating elements, coils, small-value resistors, and many other devices. Lead resistance is nulled out using a front panel control so that only the unknown resistance is measured.

Optional Touch-Hold Probe

The 80T-H probe lets an operator "hold" the displayed reading by simply depressing a button on the probe's body. The reading will not change until the button is released. The 80T-H can be used as a normal probe at other times. It works for voltage, resistance, and conductance measurements.

Overload Protection

When measuring resistance or conductance, up to 500 volts may be applied with no instrument damage. Voltage inputs can handle 1000V dc or peak ac and transients up to 6 kV. The 2A current input is protected with two in-series fuses—2A/250V and 3A/600V. In normal overload situations, only the common 2A/250V fuse will blow. The 3A/600V back-up fuse protects the DMM should the 2A/250V fuse ionize when accidentally attached to a source of more than 250 volts—like a 480-volt power line.

Extended Measurements

Optional accessories enable you to extend the measurement capabilities of the 8010A and 8012A. For example, measure current to 600A, rf voltage to 500 MHz, voltage to 40 kV, and temperature to 1000°C (1832°F).

Specifications

Technical Specifications

All accuracy specifications are for one year after purchase or recalibration when operated in a temperature range of 18°C to 28°C.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V
Resolution: 100 µV on lowest range 1V on 1000V range
Accuracy: (±0.1% of reading + 1 digit) on all ranges
Input Impedance: 10 MΩ on all ranges
Normal Mode Noise Rejection: ≥60 dB at 60 Hz or 50 Hz
Commom Mode Noise Rejection: ≥90 dB at dc, 50 Hz, and 60 Hz, with 1 kΩ unbalance
Overload Protection: To 1000V dc or peak ac on any range
Response Time: 1 second maximum

AC Voltage (True RMS, AC Coupled)

Range	Resolution	Accuracy: ±(% of Reading + Digits)				
		45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
200 mV 2V 20V 200V	100 µV 1 mV 10 mV 100 mV	0.5% + 2			1.0% + 2	5% + 3
750V	1V	0.5% + 2	Not specified			

**Accuracy applies from 5% to 100% of range*

Useful Frequency Range: Typically ±3 dB at 200 kHz
Input Impedance: 10 MΩ in parallel with <100 pF
Commom Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz with 1 kΩ unbalance
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Overload Protection: To 750V rms, 1000V peak, not to exceed 10^7 volt hertz product (10 seconds maximum on 200 mV and 2V ranges)
Response Time: 2 seconds maximum

Resistance

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Full Scale Voltage	Max Test Current
2Ω 20Ω	1 mΩ 10 mΩ	1.0% + 2 0.5% + 2	0.02V 0.2V	10 mA 10 mA
Note...above ranges in 8012A only				
200Ω 2 KΩ* 20 kΩ 200 kΩ*	0.1Ω 1Ω 10Ω 100Ω	0.2% + 1	<0.25V >1.0V <0.25V <1.0V	1.30 mA 1.30 mA 10.0 µA 35.0 µA
2000 kΩ 20 MΩ*	1 kΩ 10 kΩ	0.5% + 1	<0.25V >1.5V	0.10 µA 0.35 µA

**Diode Test ranges*

Diode Test: The three diode test ranges are marked with a diode symbol and have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with the larger diode symbol. The non-diode test ranges will not turn on silicon junctions when making in-circuit resistance measurements.
Open Circuit Voltage: <3.5V on all ranges except <16V on 2Ω and and 20Ω ranges
Input Protection: To 300 V dc or rms on 2Ω and 20Ω ranges. 500V dc on all other ranges
Response Time: 1 second on all ranges except 2000 kΩ and 20 MΩ where time is 4 seconds, maximum

Conductance

Conductance is the inverse of ohms (1/Ω) and is expressed in Siemens (S), formerly mhos

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Full Scale Voltage	Max Test Current
2 mS	1 µS	0.2% + 1	<3.5V	1.3 mA
20 µS	10 nS	0.2% + 1	<1.0V	10 µA
200 nS	0.1 nS	1.0% + 10	<1.0V	0.1 µA

Equivalent resistance
2 mS Range: 500Ω to 1 MΩ
20 µS Range: 50 kΩ to 100 MΩ
200 nS Range: 5 MΩ to 10,000 MΩ
Input Protection: To 500V dc or rms on all ranges

DC Current

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Burden Voltage
200 µA 2 mA 20 mA 200 mA	0.1 µA 1 µA 10 µA 100 µA	0.3% + 1	0.3V max
2000 mA	1 mA		0.9V max
10A*	10 mA	0.5% + 1	0.5V max

**This range in 8010A only*

Overload Protection: 2A, 250V front panel fuse in series with 3A/600V front panel fuse. 10 ampere range in 8010A not fused, 12A maximum
Response Time: 1 second maximum

AC Current (True-RMS, AC Coupled)

Range	Accuracy: ±(% of Reading + Digits)*				Burden Voltage
	45 Hz	2 kHz	10 kHz	20 kHz	
200 µA 2 mA 20 mA 200 mA	1% + 2		2% + 2		0.3V max
2000 mA 10A**	1% + 2	Not specified			0.9V max 0.5V max

**Applies from 5% to 100% of range*
***This range in 8010A only*

Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Response Time: 2 seconds maximum
Other Specifictions: Same as for dc current

General Specifications

Display: 3-1/2 digit (2000 counts), LCD, autozero, autopolarity
Common Mode Voltage: 500V dc or peak ac, maximum
Touch and Hold: Holds a voltage or resistance reading when the mA jack is monentarily shorted to COMMON. Accessory probe 80T-H is recommended.
Temperature: 0°C to +50°C, operating; -40°C to +60°C non-operating, except -40°C to +50°C with batteries
Temperature Coefficient: <0.1 times the applicable accuracy specification per °C, from 18°C to 0°C and 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤90% to 35°C except for 2000 kΩ 20 MΩ, and 200 nS ranges where it is ≤80% to 35°C
Power: 90 to 132 ac or 200 to 264V ac, 50 or 60 Hz, 2W for standard models. With battery version (-01), voltage and frequency range is selectable with internal switches, 3.5W.
Batteries: Rechargeable NiCd batteries and recharge circuits installed in version -01. Recharge time approximately 14 hours. "BT" on display appears when approximately 1/2 hour of operation remains. Fifteen to thirty hours of operation typical of full charge, depending on functions used
Size: 6 cm H x 22 cm W x 25 cm D (2.5 in H x 8.5 in W x 10 in D)
Weight: 1.08 kg (2.38 lb) for standard models. 1.42 kg (3.13 lb) for version -01 with batteries
Included: Manual, line cord, test leads (Y8131), statement of calibration practice

8010A & 8012A

Ordering Information

Models

January 1989 prices

8010A DMM w/10A Range	$329
8010A-01 DMM w/Batteries	369
8012A DMM w/2Ω and 20Ω Range	359
8012A-01 DMM w/Batteries	399

Accessories (Also see page 127)

Y8131 Replacement Test Leads	11
Y8133 Deluxe Test Lead Set	22
Y8140 Slim Test Leads w/needle points	20
C86 Ruggedized Carrying Case	20
Y8205 Soft Carrying Case	35
80T-H Touch-Hold Probe	59
83RF 100 MHz RF Probe	55
85RF 500 MHz RF Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
80K-6 High Voltage Probe	49
80K-40 High Voltage Probe	85
80J-10 Current Shunt	35
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-600 Ac Current Probe	119
M00-200-611 3 1/2" Rack Adapter, Offset	50
M00-200-612 3 1/2" Rack Adapter, Center	50
M00-200-613 3 1/2" Rack Adaper, Dual	60

Service & Support

Warranty

One year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-8010A Repair (w/calibration)	20
SC1-8010A Repair (cal w/in or out data)	35
SC1-8010A Repair (cal w/in and out data)	50
SC2-8010A Cal (1/yr recommended)	27
SC2-8010A Cal (1/yr w/in or out data)	42
SC2-8010A Cal (1/yr w/in and out data)	57
SC1 8010A-01 Repair (w/calibration)	24
SC1 8010A-01 Repair (cal w/in or out data)	39
SC1 8010A-01 Repair (cal w/in and out data	54
SC2 8010A-01 Cal (1/yr recommended)	27
SC2 8010A-01 Cal (1/yr w/in and out data)	42
SC2 8010A-01 Cal (1/yr w/in and out data)	57
SC1-8012A Repair (w/calibration)	20
SC1-8012A Repair (cal w/in or out data)	35
SC1-8012A Repair (cal w/in and out data	50
SC2-8012A Cal (1/yr recommended)	27
SC2-8012A Cal (1/yr w/in or our data)	42
SC2-8012A Cal (1/yr w/in and out data)	57
SC1-8012A-01 Repair (w/calibration)	24
SC1-8012A-01 Repair (cal w/in or out data)	39
SC1-8012A-01 Repair (cal w/in and out data)	54
SC2-8012A-01 Cal (1/yr recommended)	27
SC2-8012A-01 Cal (1/yr w/in or out data)	42
SC2-8012A-01 Cal (1/yr w/in and out data)	57

Automatic RCL Meter

PM 6303

PM 6303

PM 6303 Automatic RCL Meter

- Easy-to-read LCD display
- Extremely fast automatic operation
- Displays component value, measurement units and equivalent circuit
- All displays appear simultaneously
- One or two push-button selection of nine different parameters
- Two- or four-wire connection
- SMD Testing via Optional Test Attachment

Fast Operation, Clear Display

The PM 6303 automatic RCL meter will rapidly determine the value, electric dimension and equivalent - circuit of passive components to a very high order of accuracy, and over a wide range. The measured value, together with the appropriate unit of measurement and the equivalent circuit-graphics, are easily read on a large 4-digit liquid crystal display.

Rapid Connection

Connection of a component to be tested is effected easily and rapidly, using either a two- or four-wire connector or an optional test attachment. Less than one second after connection, the dominant component's measured value, its effective dimension and its equivalent circuit, will be clearly displayed. For example: when measuring a coil having a Q-factor of 1, both the series inductance and resistance and the equivalent circuit-graphics will be displayed almost instantly. Apart from using the auto mode of the PM 6303, it is possible to select from a maximum of nine differing parameters (D, Q, Rp, Rs, Z, Ls or Lp, Cs or Cp and Cs 2V bias), using only two push-buttons.

Universal Capability

Features like these make the PM 6303 an ideal instrument for a very wide range of applications; educational-institutes R & D laboratories, specialized service centers, or in general-purpose workshops. Its automatic operation, coupled with a direct digital readout, also makes the PM 6303 a most attractive proposition for use in research, development, and in quality-control; manufacturing engineers, too, will find the PM 6303 a most useful aid in batch-sampling techniques.

Connection Facilities

- 2 sockets for measuring voltage (HI) Drive and Sense connection
- 2 sockets for measuring current (LO) Drive and Sense connection
- 1 socket guard connection

Parameter Selection

- 2 push-buttons for stepping from item to item in the parameter menu.
- 1 push-button to reset to RCL AUTO mode in which the dominant component is measured.

Parameters

- Dominating component R, C or L (autoselection)
- Q
- D
- Rp
- Rs
- Z
- Cp, Lp
- Cs, Ls
- Cp Biased (internally generated DC voltage)

Optional Accessories

When making measurements of already mounted components, connection between the PM 6303 and the component to be tested can be difficult. The problem is easily overcome by the use of the 4-wire test cable PM 9541. This consists of a cable fitted at one end with Kelvin clips, the other end fitted with a Kelvin connector which plugs into the front panel socket on the PM 6303.

In addition, and especially useful for testing batches of individual components of all different physical sizes, there is the 4-wire RCL adapter, PM 9542. This is a box-mounted set of 'slide-in' connectors having a similar cable end to PM 9541.

Also available is a fixture for all types of SMDs (Surface Mounted Devices). It plugs into the PM 9542 and allows measurment on and testing of all shapes and sizes of SMDs. A direct readout of the component type and value is displayed on the PM 6303, together with a display of the equivalent-circuit symbol for the component. As for other components, a 4-wire technique is used for measurment, ensuring high accuracy even for low-impedance components.

All three accessories may be seen on the following page.

Specifications

Technical Specifications

General

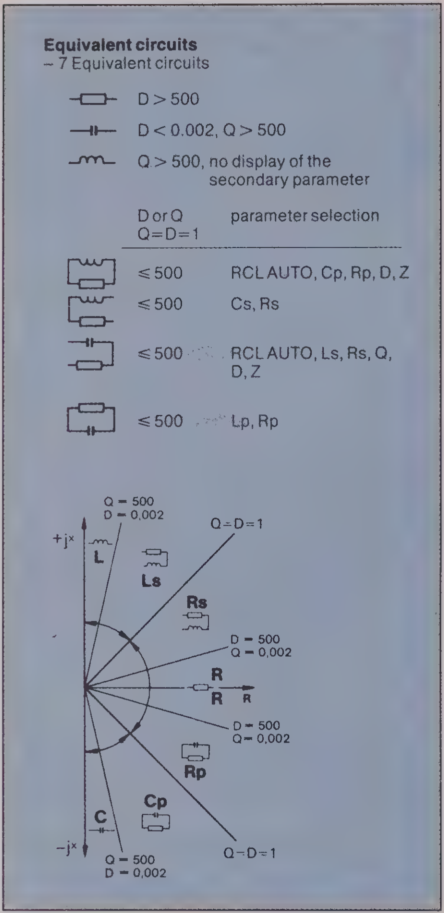
Display: Large 18mm, 4-digits LCD
Dimension Indications: Ω, kΩ, MΩ, pF, nF, μF, mF, μH, mH, H, kH
Out of Range Indication: 4 middle digit segments flashing

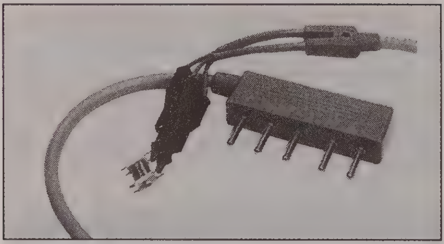
Measuring Ranges

Resistance: Rp, Rs, Z 0.000Ω...200 MΩ
Capacitance: Cp, Cs 0.0 pF...100 mF
Inductance: Lp, Ls 0.0 μH...32 kH
Quality Factor: Q 0.002...500
Dissipation Factor: D 0.002...500

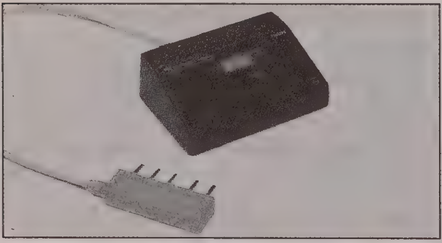
Automatic RCL Meter

PM 6303

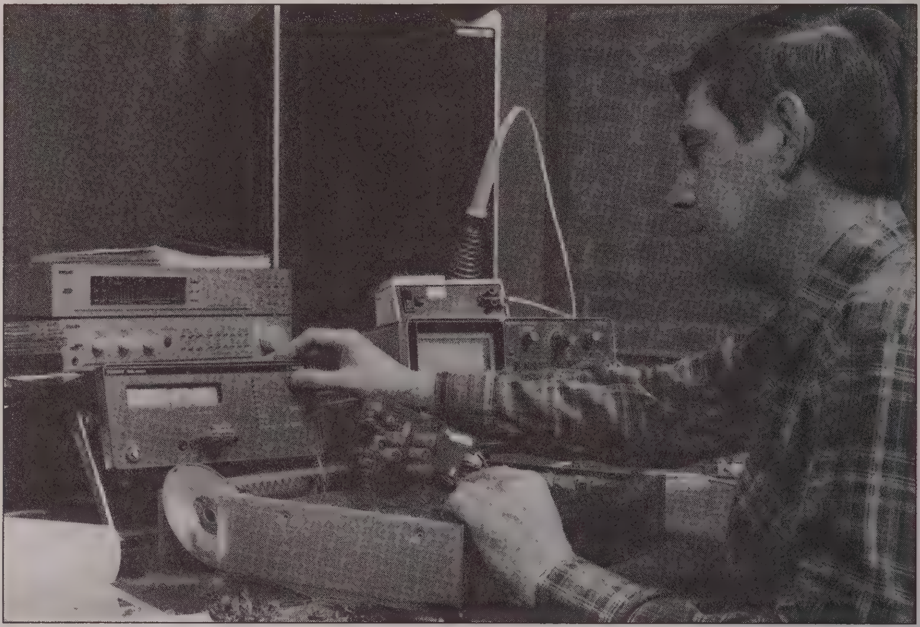




4-wire test cable PM 9541 (optional)



4-wire RCL adapter PM 9542 with SMD adapter PM 9542SMD (optional)



PM 6303 is extremely versatile making it a valuable measurement tool in industry, service workshop or education.

	PM 9541	PM 9542*
Performance characteristics:		
DUT-connection	by two Kelvin clips	by Kelvin contacts in the test pods
Short-circuit inductance	0.1 µH typical 10.3 µH max.	<0.1 µH max.
Mechanical specifications:		
Cable length	600 mm	600 mm
Case dimension	—	50 x 145 x 95 mm
Weight	0.2 kg	0.6 kg

** Alone or combined with 9542SMD*

Maximum Resolution per Range

Resistance: 1 mΩ
Capacitance: 0.1 pF
Inductance: 0.1 µH
Quality/Dissipation Factor: 0.001
Measuring Accuracy: Basic Error ±0.25% ±1 digit
Measuring Frequency: 1 kHz ±0.025%
DUT Stress: ≤5 mA, ≤2V (linked to a 2 V_{RMS} source with an internal resistance of 400Ω)
Type of Connectors: 4 mm sockets
2 sockets for measuring voltage (HI)
Drive and Sense connection
2 sockets for measuring current (LO)
Drive and Sense connection
1 socket guard connection
Measurement Update Rate: Approx. 2 measurements per second
Zero Capacitance Adjustment: Co-trim by means of screwdriver adjustment on front panel.
Maximum Adjustable Capacitance: 5 pF

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Frequency: 50...100 Hz ±5%
Power Consumption: 13W

Environmental Capabilities

Ambient Temperatures
Reference Value: +23°C ±1°C
Operation: +5°C + 40°C
Storage and Transport: -40°C...+70°C
Dimensions: 310 mm W x 140 mm H x 310 mm L (12.2 in W x 5.15 in H x 12.2 in L)
Weight: 4.8 kg (10.6 lb)
Included: Two-terminal fixture and operating manual

Ordering Information

Model

January 1989 prices

PM 6303/008 Automatic RCL Meter $1295

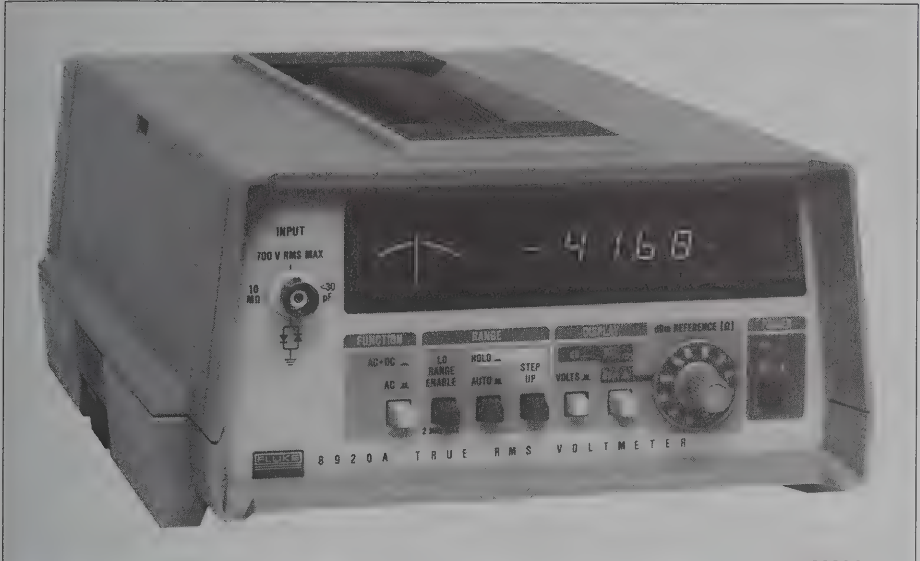
Accessories (Also see page 127)

PM 9541/00 Four-wire test cable	55
PM 9542 RCL test adapter	250
PM 9542SMD SMD adapter for PM 9542	90

Note: The above configurations meet North American power requirements. For other power options, see page 491.

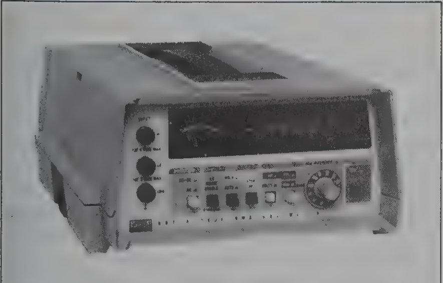
8920A/8921A/8922A

GPIB
IEEE-488

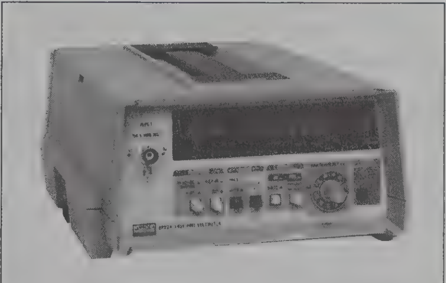


8920A

8920A/8921A/8922A Wideband Digital Voltmeters
True-rms ac with readout in volts or dB
Ac or ac + dc measurements
Autoranging
Selectable dBm reference impedance
Analog display for peak/null adjustments
Rear panel linear analog output (Models 8920A & 8922A)
Relative dB measurements
10 Hz to 20 MHz or 2 Hz to 11 MHz (Model 8922A)
180 µV to 700V



8921A



8922A

Choice of Bandwidth

Bandwidth capabilities of the 8920-Series Voltmeters encompass many applications, from testing high-frequency oscillators, attenuator flatness and amplifier frequency response to microphone levels, phono-pickup devices, vibration tests and wideband noise levels to list only a few. Models 8920A and 8921A cover a bandwidth of 10 Hz to 20 MHz. The 8922A offers low-frequency capabilities in the 2 Hz to 11 MHz bandwidth and a switchable 200 kHz low pass filter which eliminates unwanted high-frequency noise from the measured signal.

True RMS Converter

The heart of all 8920-Series Voltmeters is Fluke's monolithic thermal converter which can measure rms values of an ac signal. This patented semiconductor circuit balances the heating power of a dc feedback signal against the heating power of the ac input voltage, producing a true rms equivalent dc output. This unique converter enables Fluke voltmeters to provide wideband, low-noise, accurate measurements at a low cost.

Selectable dBm Reference Impedance

Fluke's 8920-Series Voltmeters permit an operator to select any one of 12 reference impedances from 50Ω to 1200Ω and to digitally read out dB values referenced to the selected level. Input impedance is constant at 10 MΩ for all settings of the dB reference control. This minimizes circuit loading and allows the operator to add the appropriate termination externally. Zero dB corresponds to 1 mW for each of the selectable levels.

AC or AC + DC Functions

The input coupling capabilities of the 8920-Series Voltmeters help solve difficult measurement problems. Without these features, whenever an operator is required to measure a signal which (1) is not symmetrical, (2) has unequal excursions above and below zero, or (3) has a dc component, it is necessary to go through a series of computations to determine the actual rms voltage value. First, the signal has to be measured with a dc voltmeter (providing its ac rejection is sufficient) and then with an ac voltmeter. Finally, the sum of the squares of the two readings must be calculated and the square-root extracted from the result. Failure to consider the dc component by using only an ac-coupled meter can result in substantial error.

Relative dB Measurements

The relative reference feature of the 8920-Series Voltmeters allows direct readings of gain or attenuation. Depressing the REL switch sets the existing dB reading to zero, establishing the input voltage level as the relative dB reference. Subsequent readings of higher voltages will be displayed as +dB, lower voltages as -dB.

8920A/8921A/8922A

Autoranging

Fluke's autoranging feature allows you to carry out your testing without having to change ranges manually. A range can be placed on HOLD or manually stepped up to a higher range. On HOLD, the meter will remain in a given range regardless of changes in input levels. On STEP UP, the meter will increase ranges step-by-step until the switch is released.

Peaking/ Dipping Meter

In addition to an accurate digital display, all Fluke Voltmeters in the 8920-Series feature an analog meter for peak and null voltage adjustments. The meter indicates 0 to 100 percent full scale in each range.

Linear Analog Output

Models 8920A and 8922A are equipped with a rear panel output for driving X-Y or strip chart recorders, delivering voltages proportional to the display count. A 2-volt level equals 2000 counts, a 1-volt level equals 1000 counts, etc. This feature is not available on Model 8921A.

Accuracy

Fluke Digital Voltmeters avoid the possibilities for error so common in analog meters. The digital displays eliminate the likelihood of misreading the meter due to viewing angle problems of parallax common with analog meters. Also, the accuracy of 8920-Series Voltmeters is specified as a percent of reading rather than as percent of full scale.

Percent of reading accuracy does not degrade for measurements at the low end of a scale. Front panel switching offers a choice of readings in dB or volts.

Specifications

Technical Specifications

The accuracy specifications below apply from 9% to 100% of full scale and from 18°C to 28°C for 90 days. For six-month specifications multiply figures by 1.5.

AC Accuracy: ± % of voltage reading or ±dB (8920A/8921A)

Range	2 Hz – 10 Hz	10 Hz – 20 Hz	20 Hz – 50 Hz	50 Hz – 10 kHz – 200 kHz	200 kHz – 1 MHz	1 MHz – 2 MHz	2 MHz – 10 MHz	10 MHz – 20 MHz
700V 200V	Not Specified	5% or 0.5 dB	1% or 0.15 dB	0.5% or 0.1 dB	0.7% or 0.15 dB	Not Specified		
20V 2V 200 mV						3% or 0.35 dB		5% or 0.5 dB
20 mV			2% or 0.245 dB	1% or 0.15 dB	2% or 0.25 dB	4% or 0.4 dB		
2 mV			3% or 0.35 dB	2% or 0.25 dB	3% or 0.35 dB			

AC Accuracy: ± % of voltage reading or ±dB (8922A)

Range	2Hz – 10Hz	10Hz – 20Hz	20Hz – 50Hz	50Hz – 10kHz	10kHz – 200kHz	200kHz – 1MHz	1MHz – 2MHz	2MHz – 11MHz	11MHz –
	FILTER IN				FILTER OUT				
700V 200V	3% or* 0.35 dB 5% or 0.5 dB	1% or* 0.15dB 5% or 0.5 dB	1% or 0.15dB	0.5% or 0.1 dB		0.7% or 0.15 dB	Not Specified		
20V 2V 200 mV							3% or 0.35 dB	5% or 0.5 dB	
20 mV		2% or* 0.25 dB	2% or 0.25 dB	1% or 0.15 dB		2% or 0.25 dB			
2 mV	5% or* 0.5 dB**	5% or 0.5 dB	3% or 0.35 dB	2% or 0.25 dB	4% or 0.4 dB				

**Valid when AC + DC DAMPING is selected and input has no dc components.*

***Below 2 mV add number of digits (N) to ±5% voltage readings, where N = 5 ÷ mV input. Or, for dB readings, add N to ±0.5 dB, where N = 0.5 ÷ (mV input)^2*

AC+DC Accuracy: Add to AC accuracy specifications (above) ±10 digits or ±0.5 dB above 2 mV, or ±100 digits or ±5.0 dB below 2 mV. For dc only, add above digits to 50 Hz to 10 kHz specifications

Functions: True RMS measurements only. AC or AC + DC (8920A and 8921A); AC or AC + DC with damping (8922A)

Maximum Input: 700V rms or 1000V peak, not to exceed a volt-hertz product of 1 x 10^8 on any range

Maximum Common Mode Voltage

8920A and 8922A: 400 mV rms or 600 mV peak

8921A: 500V rms or 700V peak

AC Common Mode Rejection: ≥60 dB at 50 and 60 Hz with 100Ω unbalance

DC Common Mode Rejection: ≥100 dB, 100Ω unbalance

Crest Factor: 7 at full scale, increasing down scale by 7 times the voltage range divided by the voltage input. Degrades below 10 Hz, annunciated when capability exceeded (8922A only)

Input Impedance: 10 MΩ shunted by <30 pF

Voltage Ranges: 2 mV, 20 mV, 200 mV, 2V, 20V, 200V, 700V

Ranging: Autoranging with HOLD to defeat auto ranging and STEP UP for manual ranging. Ranges up at 2000 counts and ranges down at 180 counts

Decibel Ranges: In the autorange mode, the instrument appears as though it has a single range spanning 131 dB

dBm Reference: Twelve user-selectable impedances are provided to reference a 0 dBm, 1 mW level (50Ω, 75Ω, 93Ω, 110Ω, 124Ω, 135Ω, 150Ω, 300Ω, 600Ω, 900Ω, 1000Ω, and 1200Ω) (dBV = 1000Ω)

Relative dB Reference: A voltage input present when this button is pushed is held as "0 dB" reference point. Subsequent readings indicate ± deviations from this point

Voltage Resolution: 0.05% of ranges (3$^1/_2$ digits)

Decibel Resolution: 0.01 dB (4 digits)

Typical-3 dB Points: 40 MHz on 20 mV thru 20V ranges and 4 MHz on 2 mV range (8920A/8921A); 22 MHz on 2 mV to 20V ranges (8922A)

Low Pass Filter: Approximately 200 kHz -3 dB point, on 8922A only

Reading Rate: 2.5/s or 1/s with ac + dc with damping (8922A)

Autorange Rate: <950 ms or <3.5s with ac + dc with damping (8922A)

Response Time: (To rated accuracy) <1.6s or <7s with ac + dc with damping (8922A)

Readout: Panel-selectable for volts or dB, automatic decimal point location: analog peaking/dipping meter

LED Annunciators: Indicate "mV," "V," "dB," "REL REF," and "2 MHz MAX" for 2 mV range (8920A and 8921A) and "UNCAL" when crest factor limitation exceeded (8922A)

Overrange: Flashes maximum reading for that range

Underrange: Flashes decimal

Linear Analog Output: (8920A and 8922A only) Linear output of 2000 mV dc for a 2000-count readout; ±1.0% relative to display; essentially 0Ω output into a ≥10 kΩ load; non-isolated, with output common same as input common

Option Specifications

Counter Output Option (-03)

Drives frequency counters. Converts input signal into a 100 mV peak square wave. Greater dynamic range extends the sensitivity of counters to 180 µV at the low end and 700V at the high end. Impedance is 50Ω. Used with the 8921A, counter can measure signals elevated to 500V rms.

Logarithmic Analog Output Option (-04)

For 8920A and 8922A only. Provides an analog output voltage proportioned to the logarithm of the input voltage. Plots logarithmically-scaled graphs, dB variations. Zero volts and zero dB on the output correspond with 200 µV on input. A 13.1V output corresponds to 700V or 131 dB on the input. Therefore, 2V on the output equals 20 dB, 6V equals 60 dB, etc., making it easy to relate voltage to dB. The option provides a low-cost way of using an X-Y recorder to plot graphs as one continuous curve over any part of the 131 dB range.

PTI Interface Option (-521)

To use the 8920-Series DVM's with Fluke's own addressable Portable Test Instrument (PTI) byte-serial data bus. Output to Fluke printers, typically. Supplied with 2-foot ribbon cable Y7203.

1120A Interface Option (-522)

A "personality card" that fits in the Fluke 1120A GPIB/IEEE-488* Translator.

IEEE-488 Interface Option (-529)

The 8920-Series Voltmeters can be made compatible with IEEE Std 488-1978 by using Option -529 in combination with the Fluke Model 1120A Translator. A single 1120A will interface three Fluke instruments to the bus. Option -529 is electrically equivalent to Option -521 plus Option -522. Supports subsets SH1, AH1, T3, TE3

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

General Specifications

Temperature: -40°C to +75°C, non-operating
Relative Humidity: <80%
Shock: MIL-T-28800 all classes
Vibration: MIL-T-28800, classes 2, 3 & 4
MTBF: >10,000 hours
Power: 100V, 120V, 220V ac ±10% or 240V ac +4%, -10%, selected by internal switches, 50 to 400 Hz, 10W max
Size: 32.6 cm L x 20.3 cm W x 10.5 cm H (12.9 in L x 8.0 in W x 4.3 in H)
Weight: 2.47 kg (5.44 lb)
Included: Manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

8920A DVM, BNC Input, 10 Hz-20 MHz	$1995
8921A DVM, Banana Jack Input, 10 Hz-20 MHz	1995
8922A DVM, BNC Input, 2 Hz-11 MHz	2095

Options (for above Models)

-03 Counter Output	250
-04* Logarithmic Output (not for 8921A)	220
-521 PTI Interface	205
-521K PTI Interface field-installable	220
-522K 1120A Interface field-installable	135
-529** IEEE-488 Interface	300

**Not compatible with -521, -521K, -529*

***The -529 Option can be ordered and installed at time of manufacture only. For existing instruments which do not have -529 Option installed, an IEEE Interface can be added by ordering -521K and -522K (1120A required).*

Accessories (Also see page 127)

1120A IEEE-488 Translator	$590
Y7203 2 ft PTI Ribbon Cable	55
Y7204 5 ft PTI Ribbon Cable	70
Y2014 5¹/₄" Rack Adapter, Single	95
Y2015 5¹/₄" Rack Adapter, Dual	95
Y2020 Panel Mount Kit	95
Y2024 3-Module Power Cord	21
A90 6-Range Current Shunt	700
80J-10 10 Amp Current Shunt	35
Y9100 BNC 50Ω Attenuator (6 dB)	55
Y9101 BNC 50Ω Attenuator (14 dB)	55
Y9102 BNC 50Ω Attenuator (20 dB)	55
Y9103 50 Ohm Feedthrough Terminator	35
Y9107 BNC "T"	15
Y9109 Banana to BNC Adapter	20
Y9111 3-foot BNC to BNC Cable	20
Y9112 6-foot BNC to BNC Cable	20

Service & Support

Warranty

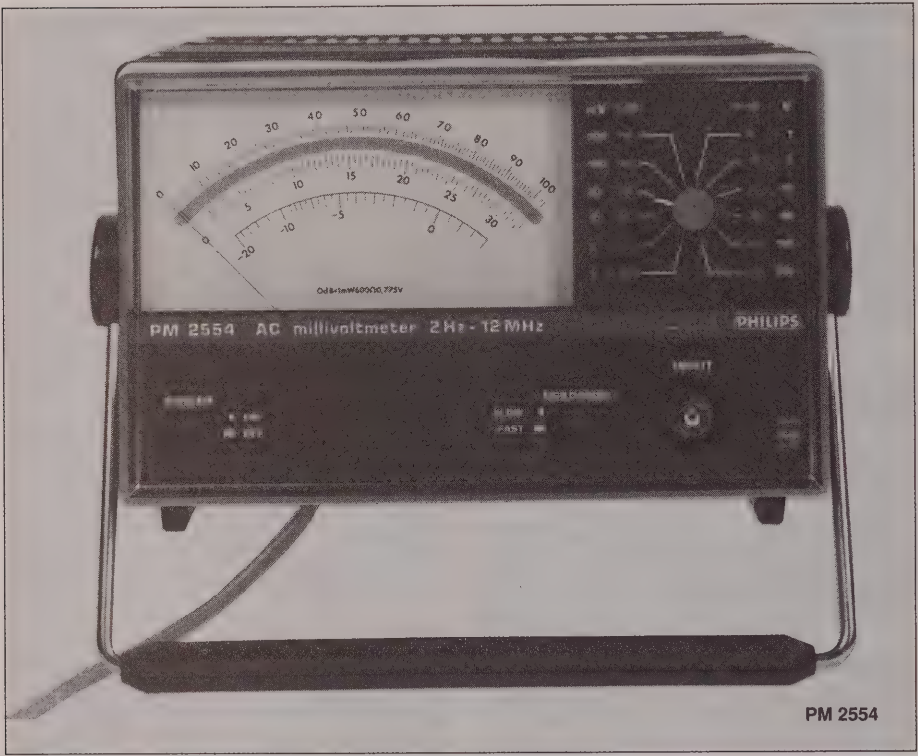
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-8920A Repair (w/ calibration)	180
SC1-8920A Repair (cal w/ in or out data)	215
SC1-8920A Repair (cal w/ in and out data)	250
SC2-8920A Cal (4/yr recommended)	252
SC2-8920A Cal (4/yr w/ in or out data)	392
SC2-8920A Cal (4/yr w/ in and out data)	532
SC1-8921A Repair (w/ calibration)	180
SC1-8921A Repair (cal w/ in or out data)	215
SC1-8921A Repair (cal w/ in and out data)	250
SC2-8921A Cal (4/yr recommended)	252
SC2-8921A Cal (4/yr w/ in or out data)	392
SC2-8921A Cal (4/yr w/ in and out data)	532
SC1-8922A Repair (w/ calibration)	193
SC1-8922A Repair (cal w/ in or out data)	228
SC1-8922A Repair (cal w/ in and out data)	263
SC2-8922A Cal (4/yr recommended)	252
SC2-8922A Cal (4/yr w/ in or out data)	392
SC2-9822A Cal (4/yr w/ in and out data)	532

AC Millivoltmeter

PM 2554

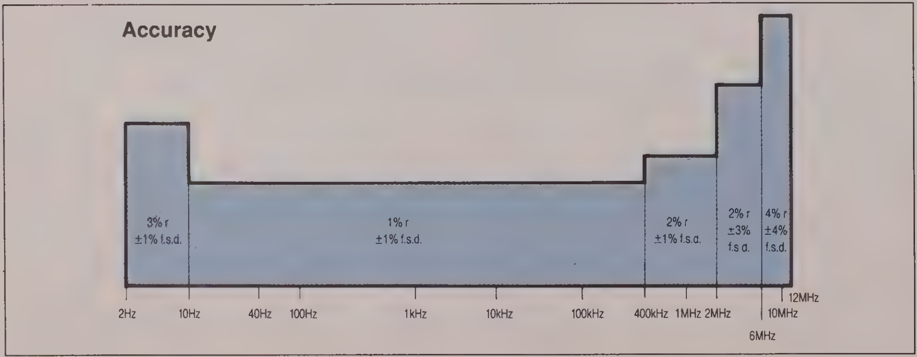


PM 2554

PM 2554 Wide Bandwidth AC Millivoltmeter

- Sensitivity 1 mV (fsd) to 300V
- Bandwidth 2 Hz...12 MHz
- High accuracy up to 1% fsd ±1% of reading
- 140 dB CMRR at 50 Hz (1 mV range)
- DC recorder output or AC output

The PM 2554 combines good accuracy with an extremely wide bandwidth (12 MHz) and voltage range (100 µV-300V). It is therefore ideal for all measurements from audio frequencies to HF and beyond. All ranges are protected from overloads of up to 300 VRMS (400 V_{DC}). Power Line voltage variations of ±10% give no more than 0.1% change in accuracy.



Specifications

Measuring Ranges: 0-300 V_{RMS} in 12 ranges from 0-1 mV to 0-300V. dB scale ranging from -80 dB to +52 dB (0 dB - 1 mV into 600Ω)
Frequency Range: 2 Hz-12 MHz
Input: Floating
Input Impedance: 1 MΩ//33 pF
Max. Voltage Low-Ground: 1 GΩ/1.4 nF
For reduction of capacitive loading, the PM 2554 can be used with the PM 8926 oscilloscope probe, input impedance 10 MΩ//11 pF
Common Mode Rejection: 140 dB at 1 kHz in 1 mV range; 120 dB at 100 kHz in 1 mV range
Accuracy: 1% fsd. + 1% of reading
Additional error for frequencies outside flat part of bandwidth - see graph
Stability: A line voltage variation of ±10% will give an additional error of 0.1% max.
Long-Term Stability: ±0.1% over 90 days
Noise At Short-Circuited Input: <30 µV
Influence of noise on measuring accuracy less than 0.5% at 10% of full scale deflection
Overload: Protected against overloads up to 300 V_{RMS} or 400 V_{DC}

Recorder Output
DC Voltage: 1V at full scale
Output Impedance: 1 kΩ
Accuracy: As specified for voltmeter

AC Output
Output Impedance: 600Ω in series with 47 µF
Output Voltage: 50 mV; Short-circuit proof
Line Voltages: 90V...132V or180V...265V; 50/60 Hz

Temperature Range
Reference Temp.: 23°C ±5°C
Operating Temperature: 0°C...45°C
Temperature Coefficient: 0.1%/°C
Size: 236 mm W x 145 mm H x 298 mm L (9.3 in. W x 5.7 in. H x 11.7 in. L)
Weight: 3.5 kg (7.7 lb)
Included: Line cable, measuring cable, instruction manual

Ordering Information

Models

	January 1989 prices
PM 2554/013 Millivoltmeter	$1460

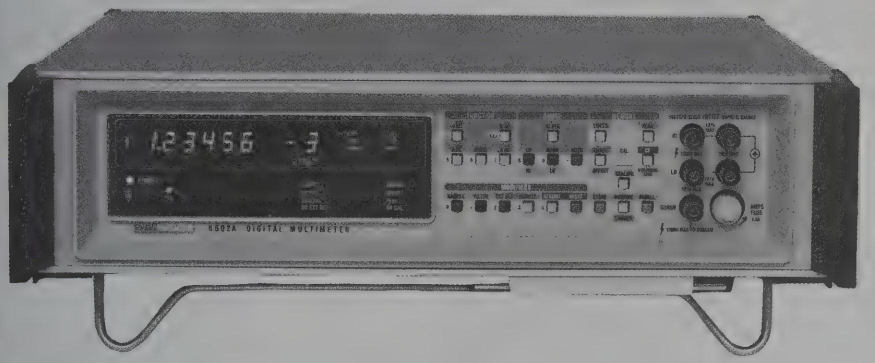
Accessories (Also see page 127)

PM 9072 Measuring Cable Banana-BNC, 135Ω	28
PM 8924/00 Passive Probe 1:1	60
PM 8926 Passive Probe 10:1	70
PM 9051 Adapter BNC-Banana	9

Note: The above configurations meet North American power requirements. For other power options, see page 491.

8502A Limited Availability

GPIB
IEEE-488



(NSN 6625-01-126-3154) **8502A**

8502A Digital Multimeter

- 6 ppm dc accuracy
- 6-1/2 digit resolution
- 500 readings per second system speed
- Modular construction for configurability
- Interface options: GPIB/IEEE-488,* RS-232-C, or Parallel
- Measurement options: AC volts, true-rms or averaging; Resistance; Current
- Up to 212% overrange

Note: In most applications, the 8505A or 8506A DMMs should be substituted.

Ordering Information

Model

Model	January 1989 prices
8502A Digital Multimeter	$5650

Options (for (8502A)

Option	Price
-01 Average Responding AC Converter	650
-02 Ohms Converter	850
-03 Current Converter	550
-04 Cal Memory	550
-05 IEEE-488 Interface	550
-06 RS-232-C Interface	550
-07A True Parallel Interface (for DEC PDP11, DR11C, DRV11)	550
-09A RMS AC Converter	735
-16 Switchable Front/Rear Inputs	550

* *All options except -16 are customer installable*

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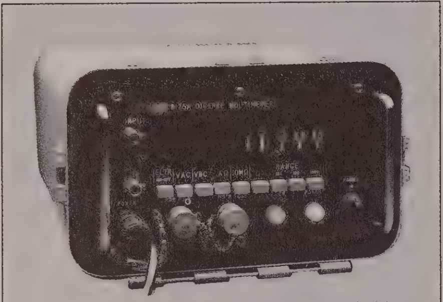
* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Limited Availability

Digital Multimeter 8125A & 8425A



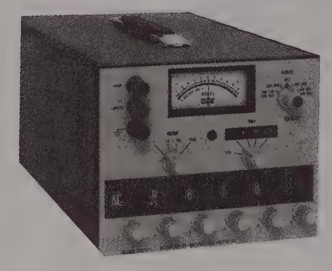
(NSN 6625-00-482-1496) **8125A**

Model 8125A is a compact, militarized 5-1/2 digit digital multimeter designed to meet MIL-T-28800B, Type II, Class 2, Style A requirements for rugged field applications. Prices on request.

Model 8425A is a ruggedized 5-1/2 digit rack mounted digital multimeter, designed for system applications, that meets the requirements of MIL-T-28800B, Type II Class 4, Style B.

The functions, ranges, and performance of the 8425A are identical to those of the discontinued 8400A. Prices on request.

Digital Voltmeters



(NSN 6625-00-451-9287) **887AB**

Fluke Differential Voltmeters, at one time, were the most accurate kind of voltmeters available. They are still exceptionally accurate but their principal remaining advantage is their extremely high input impedance for dc "at null," a setting where input voltage is most accurately measured. When measuring voltage from relatively high impedance sources, the input impedance of any voltmeter acts as a load and has a very significant effect on the accuracy of the measurement. Differential voltmeters reduce the measurement error in such cases.

Because analog meters are used on the front panel of differential voltmeters to indicate a null condition, they also provide a good visual monitor of small voltage changes and trends.

Differential Voltmeter Selection Guide

Model	DC Resolution	AC Sensing	Infinite Impedance
893A	10 µV	Average	To 1100V
895A	1 µV	N/A	To 1100V
887AB	1 µV	Average	To 11V
931B-01	N/A	True RMS	N/A

893A Differential Voltmeter	$5250
895A Differential Voltmeter	6295
887AB Differential Voltmeter	7350
931B-01 Differential Voltmeter	5590

A-90 Current Shunt

The model A-90 Current Shunt may be used for both ac and dc current measurements over six current ranges from 0.1 mA range to 10A range. A voltage of 100 mV, measurable with virtually any voltmeter, is developed at full scale on each range. Basic accuracy is ±0.15% for dc, ±0.3% for ac.

A-90 Current Shunt	700

80E-10 High Voltage Divider

The 80E-10 is a voltage divider designed for use with voltmeters in measuring up to 10,000V dc. Divider outputs at 10V and 1V are proportional to 10 kV dc input and are accurate to ±0.01%. High measurement stability and accuracy are assured through the use of Fluke manufactured precision wire-wound resistors mounted on glass-epoxy printed circuit boards.

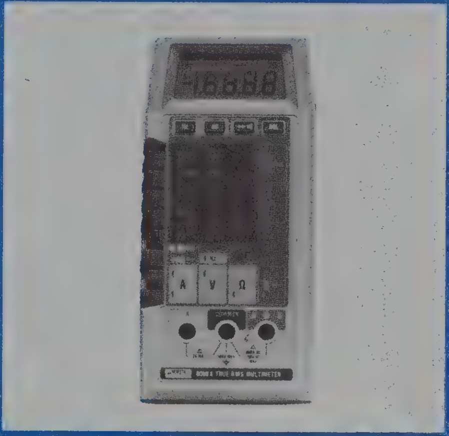
80E-10 High Voltage Divider	1325

Handheld Multimeters

Page 103 Fluke 77

Page 110 Fluke 87

Page 108 Fluke 27



Page 119 Fluke 8060A

Fluke and Philips handheld digital multimeters (DMMs) all operate from small, self-contained batteries. Some can also be operated from ac power using a battery eliminator.

Many Fluke and Philips handheld DMMs rival the performance of more expensive bench models. Others have features that make them uniquely suited for particular applications for industries. For example, the Fluke Model 25 and 27 are sealed against rain and moisture and can be used at temperatures well below freezing. The Fluke Model 87 can capture the value of high momentary motor-starting currents. The Philips PM 2618/323 mAs meter is ideally suited for medical x-ray applications. The Fluke 8060A and Fluke 87 can read the frequency of telephone touchtone signals and display ac voltages as decibel levels with respect to 1 milliwat

All Fluke and Philips handheld multimeters are designed to take electrical and physical abuse with little or no damage.

Selection Guide 102
Handheld Multimeters 103

Handheld Multimeters Selection Guide

	Basic Features		Special Features												DC Volts**		AC Volts					AC/DC Amps		Ohms, etc.				
Models	Max Display Counts*	Autoranging	Analog Bar Graph	Frequency Measurement	dB, dBm Readout	Offset/Relative Ref	Continuity & Beeper	Peak-Hold, AC/DC	Touch-Hold	Sealed Case Water/Chemical Resistant	Min/Max Hold	Milliamp Seconds (mAs)	Capacitance 5.00 nF to 5.00 μF	Duty Cycle 0.0 to 99.9%	Basic Accuracy, %	Max Resolution, μV	Max AC Voltage, w/o Probe (RMS)	True-RMS	Basic Accuracy, %	Max Resoltuion, μV	Frequency Range, Hz	Max Resolution, μA	Max Amps, w/o Probe	Max Resolution, mΩ	Max Resistance, MΩ	Diode test	Conductance (Low) > 20 MΩ	**Page**
Fluke 73	3200	•	•	—	—	—	—	—	—	—	—	—	—	—	0.7	100	750	—	3.0	1k	1k	10k	10	100	32	•	—	103
Fluke 75	3200	(1)	•	—	—	—	•	—	—	—	—	—	—	—	0.5	100	750	—	2.0	1k	1k	10k	10	100	32	•	—	103
Fluke 77	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.3	100	750	—	2.0	1k	1k	10k	10	100	32	•	—	103
Fluke 21	3200	(1)	•	—	—	—	•	—	—	—	—	—	—	—	0.5	100	750	—	2.0	1k	1k	10k	0.32	100	32	•	—	106
Fluke 23	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.3	100	750	—	2.0	1k	1k	10k	10	100	32	•	—	106
Fluke 25	3200	(1)	•	—	—	—	•	—	•	•	—	—	—	—	0.1	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	108
Fluke 27	3200	(1)	•	—	—	•	•	—	•	•	•	—	—	—	0.1	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	108
Fluke 83	4000	(1)	•	•	—	•	•	—	•	(6)	(7)	—	•	•	0.3	100	1000	—	1.0	100	5k	0.1	10	100	40	•	•	110
Fluke 85	4000	(1)	•	•	—	•	•	—	•	(6)	(7)	—	•	•	0.1	100	1000	—	0.5	100	20k	0.1	10	100	40	•	•	110
Fluke 87	4000	(1)	(5)	•	—	•	•	•	•	(6)	(7)	—	•	•	0.1	100	1000	•	0.5	100	20k	0.1	10	100	40	•	•	110
8025B	3200	(1)	•	—	—	•	•	—	•	•	•	—	—	—	0.2	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	127
8024B	2000	—	—	—	—	—	•	•	(2)	—	—	—	—	—	0.1	100	750	—	0.75	100	5k	1	2	100	20	•	•	115
8026B	2000	—	—	—	—	—	•	—	—	—	—	—	—	—	0.1	100	750	•	0.5	100	10k	1	2	100	20	•	•	115
8020B	2000	—	—	—	—	—	•	—	—	—	—	—	—	—	0.1	100	750	—	0.75	100	5k	1	2	100	20	•	•	115
8021B	2000	—	—	—	—	—	•	—	—	—	—	—	—	—	0.1	100	750	—	1.0	100	450	1	2	100	20	•	—	115
8060A	20,000	—	—	•	•	•	•	—	—	—	—	—	—	—	0.04	10	750	•	0.2	10	100k	0.01	2	10	300	•	•	119
8062A	20,000	—	—	—	—	•	•	—	—	—	—	—	—	—	0.05	10	750	•	0.5	10	30k	0.01	2	10	300	•	—	119
PM 2518	2K/11K	(1)	•	—	•	•	•	—	—	—	—	—	—	—	0.1	100	750	(3)	0.5	100	40k	10	10	100	100	•	—	123
PM 2618	2K/11K	(1)	•	•	•	•	•	—	—	—	—	(4)	—	—	0.07	100	750	(3)	0.4	100	70k	10	10	100	100	•	—	123
PM 2718	2K/11K	(1)	•	•	•	•	•	—	•	—	(7)	—	—	—	0.04	100	750	(3)	0.3	100	100k	10	10	100	100	•	—	123

•	*Standard*	*(1) Or manual ranging*	*(4) For PM 2618/323*
—	*Not applicable*	*(2) Use Peak-Hold Mode*	*(5) Analog Pointer*
*	*All displays LCD*	*(3) AC Coupled*	*(6) Splash and dust proof*
**	*Max DC Voltage w/o Probe 1000V*		*(7) MINMAX Average*

For Bench/System Multimeters see page 59.
For Multimeter Accessories see page 127.

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

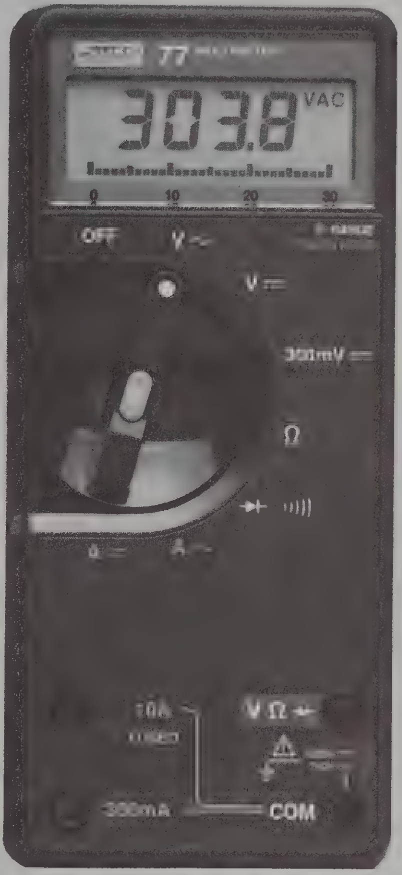
73, 75 & 77

LISTED UL 1244

Fluke 73

LISTED UL 1244

Fluke 75



LISTED UL 1244

Fluke 77

Fluke 73 Multimeter

- 3-1/2 digit, 3200 count display
- 31 segment analog bar graph
- 0.7% basic dc accuracy
- Single rotary switch control
- Autoranging selection
- 2000 hour battery life
- "Sleep Mode" extends battery life
- One current range: 10A
- 3 year warranty, 1-year calibration cycle
- Inputs overload protected and10A fused

Fluke 75 Multimeter

- 3-1/2 digit, 3200 count display
- 31 segment analog bar graph
- 0.5% basic dc accuracy
- Single rotary switch control
- Autoranging & manual selection
- 2000 hour battery life
- "Sleep Mode" extends battery life
- 3 current ranges: 10A, 320 mA & 32 mA
- 3 year warranty, 1-year calibration cycle
- Inputs overload protected and 10A fused
- Continuity beeper

Fluke 77 Multimeter

- 3-1/2 digit, 3200 count display
- 31 segment analog bar graph
- 0.3% basic dc accuracy
- Single rotary switch control
- Autoranging and manual selection
- 2000 hour battery life
- "Sleep Mode" extends battery life
- 3 current ranges: 10A, 320 mA & 32 mA
- 3 year warranty, 1-year calibration cycle
- Inputs overload protected and 10A fused
- Touch Hold® to capture readings
- Multipurpose protective holster
- Continuity beeper

73, 75 & 77

These digital multimeters with analog bar graph display utilize the latest advances in microcircuit technology without compromising quality or capability. The result is a series of meters with features never before found, not even on expensive instruments.

Digital/Analog

The Model 73, 75, and 77 provide a 3200 count digital display that gives extended resolution and a 31 segment bar graph that reacts 10 times faster than the numerical display, allowing you to make peaking and dipping adjustments easier than with digital-only DMMs.

Autoranging

With autoranging, you choose the function you want and the meter automatically selects the range with the greatest accuracy and resolution. Symbols on the liquid crystal display remind you what is being measured and the range of measurement.

Range Hold (75, 77)

Since repetitive go-no-go tests and peaking/dipping adjustments are more easily done using one range, the manual range function will prove a real boon to users making these tests frequently. Touching the pushbutton once prevents the meter from changing ranges. Pushing the button again changes the range, and holding the button down for a couple of seconds restores the "Autorange" function.

Audible Tones (75, 77)

A continuous audible tone provides a fast check for continuity of current paths having 150 ohms or less. A brief tone indicates a voltage drop of about 0.6 volts, the normal forward bias for semiconductor devices passing about 500 microamps.

Touch Hold® (77)

Touch Hold® captures a reading and displays it from memory even after the probe has been removed from the circuit. As soon as the reading stabilizes, the meter makes a distinctive audible chirp and automatically holds the reading. Touch Hold® reduces the chance of circuit damage when a probe slips and contacts two points at once because you can concentrate on touching the right test point and nothing else. Touch Hold® reduces the risk of electrical shock and also gives the user time to log the reading if needed or refer back to the reading before the next measurement.

Multipurpose Holster (77)

Our multipurpose holster is made of a tough resilient plastic that snaps over the instrument, protecting it from even the most severe shock. Both test leads may be snapped into the holster in a position so only one hand is needed to hold both the meter and probe tip in contact with the test point. You can also hang the meter on your belt or for easy viewing while probing, tilt it back on its bail for bench use.

Specifications

Technical Specifications

Accuracy specifications apply for 1 year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90% (80% for 32Ω resistance range) unless otherwise noted.

DC Voltage

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
320 mV	0.1 mV	0.7%+1	0.5%+1	0.3%+1
3.2V	1 mV			
32V	10 mV			
320V	100mV			
1000V	1V	0.8%+1	0.6%+1	0.4%+1

Input Resistance: 10 MΩ
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥ 120 dB for dc, 50 Hz, and 60 Hz
Overload Protection: 500V dc or rms ac for 320 mV range and 1000V dc or 750V rms ac for other ranges
Response Time: ≤1 second to rated accuracy

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
3.2V	1 mV	3%+2*	2%+2*	2%+2*
32V	10 mV	3%+2**	2%+2**	2%+2**
320V	100 mV			
750V	1V			

** 45 Hz to 500 Hz*
***45 Hz to 1 kHz*
Typical frequency response is -0.5 dB at 10 kHz on the 32V and 320V ranges and ±3 dB at 5 kHz on the 3.2V and 750V range.

Input Impedance: 10 MΩ and ≤50 pF on all ranges
Common Mode Noise Rejection: ≥60 dB dc to 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc, 750V rms ac
Response Time: ≤ 2 seconds to rated accuracy

DC Current

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
32 mA	0.01 mA	–	1.5%+2	1.5%+2
320 mA	0.1 mA	–	2%+2	2%+2
10A	10 mA	2%+2	1.5%+2	1.5%+2

Voltage Burden: 0.2V on 32 mA range, 2.0V max. on 320 mA range, 0.5V on 10A range
Input Protection: 630 mA/250V fuse in series with 0.36Ω fusible resistor for 300 mA input; 15A/600V fuse on 10A input
Response Time: ≤1 second to rated accuracy

AC Current (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
32 mA	0.01 mA	–	3%+2*	3%+2*
320 mA	0.1 mA	–		
10A	10 mA	3%+2*		

** 45 Hz to 1 kHz*

Voltage Burden: 0.2V on 32 mA range, 2.0V on 320 mA range, 0.5V on 10A range
Input Protection: 0.63A/250V fuse in series with 0.36Ω fusible resistor for 300 mA input; 15A/600V fuse on 10A input
Response Time: ≤2 seconds to rated accuracy

Resistance

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
320Ω	0.1Ω	1%+2	0.7%+2	0.5%+2
3200Ω	1Ω	0.7%+1	0.5%+2	
320kΩ	10Ω1%+1			
320 kΩ	100Ω			
3.2 MΩ	10 kΩ	3%+1	2.5%+1	2.0%+1

Open Circuit Voltage: ≤3V Full Scale Voltage: ≤440 mV on all ranges except ≤1.4V on 32 MΩ range
Input Protection: 500V dc or rms ac
Response Time: ≤10s up to 32 MΩ to rated accuracy

Continuity

Threshold: Approximately 150 ohms
Audible Tone: Continuous tone for continuity. Fluke 75 and 77 only.
Display: Less than .100 indicates continuity, OL (overload) indicates open-circuit, approximately 20,000 ohms or higher.
Response Time: Approximately 100 ms

Diode Test

Test Current: Approximately 500 µA for a normal forward biased diode
Audible Tone: Brief tone for normal forward biased diode or semiconductor junction. Fluke 75 and 77 only.
Display: An indication of approximately .600V for a normal forward biased silicon diode or semiconductor function and OL (overload) for a normal reverse biased diode or semiconductor junction
Response Time: Approximately 100 ms

Analog Display

Measurement Rate: 23 measurements per second

Touch-Hold®

Fluke 77 only. Pushbutton activated mode. Automatically holds stable reading of voltage, resistance, or current indefinately even if test probe is removed. Reading updated by touching probe to other test points.

General Specifications

Max Common Mode Voltage: 1000V dc or peak ac
Temperature: 0°C to 50°C operating; -40°C to 60° C non-operating
Temperature Coefficient: 0.1 x specified accuracy per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C, ≤90% to 35° C except ≤80% using 32 MΩ range
Safety: Protecton Class II per IEC 348, UL 1244 listed and VDE 0411 licensed
Power: Single 9V battery, NEDA 1604 9V
Battery Life: More than 2000 hours (alkaline) or 1600 hours (carbon-zinc). "Sleep Mode" extends battery life when you forget to turn power off (15 min in diode test)
Size: 166 mm L x 75 mm W x 28 mm H(6.55 in x 2.95 in x 1.12 in)
Weight: 0.28 kg (0.63 lb)
Included: TL70 Test Leads, manual, plus battery and spare fuse (installed). Also C70 Holster included with Fluke 77

Ordering Information

Models

January 1989 prices

Fluke 73 DMM w/3-year warranty	$79
Fluke 75 DMM w/beeper, w/3-year warranty	119
Fluke 77 DMM w/Touch-Hold, w/beeper, w/3-year warranty	159

**Includes C70 Multipurpose Holster*

Accessories (Also see page 127)

TL20 Test Lead Set	35
TL70 Replacement Test Leads	8
Y8134 Deluxe Test Lead Kit	22
Y8140 Test Lead Set	20
C50 Soft Carrying Case	15
C70 Multipurpose Holster	14
C100 Universal Carrying Case	30
83RF RF Probe	55
85RF RF Probe	85
80TK Thermocouple Probe	65
80T-150U Temperature Probe	120
80K-6 High Voltage Probe	49
80K-40 High Voltage Probe	85
Y8100 DC/AC Current Probe	259
Y8101* AC Current Probe	69
80i-400* AC Current Probe	69
80i-410* DC/AC Current Probe	129
80i-600* AC Current Probe	119
80i-1010 DC/AC Current Probe	229
LCA-10 Line Current Test Adapter	13

**Not applicable to Fluke 73*

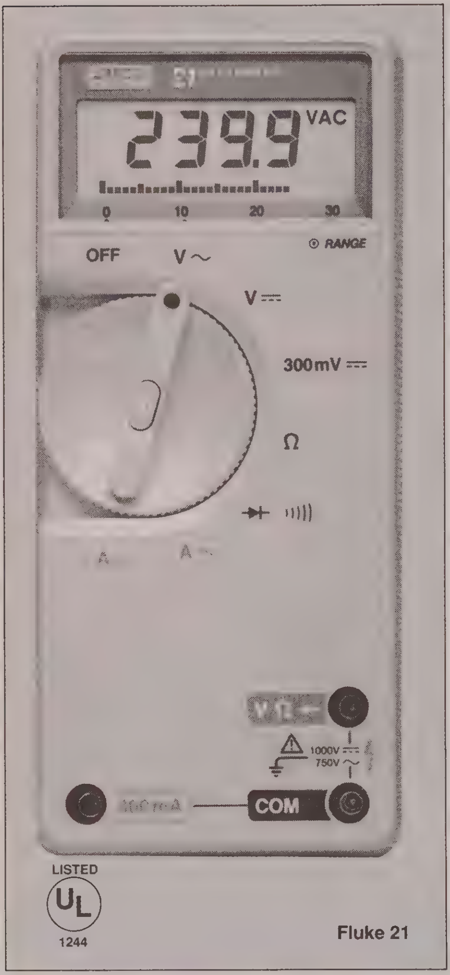
Service & Support

Warranty

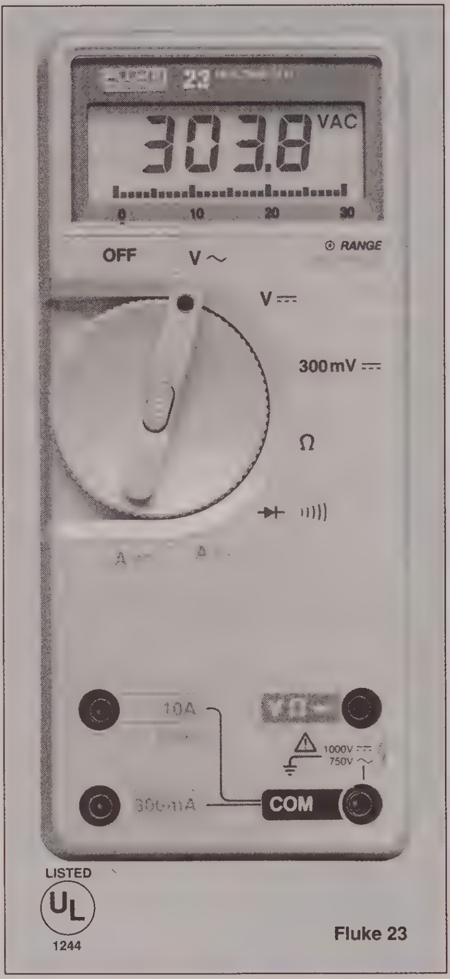
Three-year product warranty. See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)

21 & 23



Fluke 21



Fluke 23

Fluke 21 & 23 Low-Cost, High-Accuracy Multimeters

- Analog and digital display - tests changing or stable signals
- Easy to use - single rotary switch and automatic ranging
- Volts, ohms, diode test, milliamps, 10 amps (Fluke 23)
- All inputs overload protected, including 10 amps
- 3-year warranty, 1-year calibration cycle
- High visibility yellow, high impact ABS case
- Touch-Hold® (Fluke 23)
- 2000 hour battery life on a single 9V battery

Safety Designed

All inputs on the Fluke 21 and 23 are protected from high energy overloads, including the Fluke 23's fused 10 amp range. Resistance, continuity and mV functions are overload protected to 500V dc or ac rms, voltage functions to 1000V dc and 750V ac rms. Recessed input jacks accept Fluke safety designed test leads or standard banana plugs.

3200 Count Digital Display

Offers better accuracy and resolution than a conventional 3 1/2 digit (1999 count) DMM. High contrast liquid crystal display, with wide viewing angle, updates two times per second.

31-Segment Analog Bar Graph

Makes dynamic measurements such as peaking, nulling, zero adjustments and capacitor checking. Updates ten times faster than digital readout.

Fast Autoranging and Automatic Polarity

Simplifies and speeds up the use of the meter by instantly selecting the proper range. Optional manual ranging included. Reverse polarity is indicated by a "-" sign next to the reading.

Touch-Hold® (Fluke 23)

Allows automatic measurements while watching probes and circuit. The meter captures the measurement, beeps, and locks it in the display until you're ready to view it. Automatically updates with each new stable measurement value.

Audible Continuity/Diode Test

Wiring, diode and transistor checks can be done quickly without looking at the display. A continuous tone signals continuity, a beep signals a forward biased diode or transistor.

Standard Equipment

Every meter is packaged with a pair of safety designed Fluke TL70 right angle test leads, two insulated alligator clips, 9V battery installed, spare fuse and operator's manual. Fluke 23 comes with C70 protective holster that includes tilt bail, belt hook and lead storage. C70 is available as an accessory for Fluke 21.

Specifications

Technical Specifications

Accuracy specifications apply for 1 year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90% (80% for 32 MΩ resistance range) unless otherwise noted.

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
320 mV	0.1 mV	0.5% + 1	0.3% + 1
3.2V	1 mV		
32V	10 mV		
320V	100 mV		
1000V	1V	0.6% + 1	0.4% + 1

Input Resistance: 10MΩ
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB for dc 50 Hz and 60 Hz
Overload Protection: 500V dc or rms ac for 320 mV range and 1000V dc or 750V rms ac for other ranges

Response Time:≤1 second to rated accuracy

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
3.2V	1 mV	2% + 2*	2% + 2*
32V 320V 750V	10 mV 100 mV 1V	2% + 2**	2% + 2**

** 45 Hz to 500 Hz　**45 Hz to 1 kHz*

Typical frequency response is -0.5dB at 10 kHz on the 32V and 320V ranges and ±3dB at 5 kHz on the 3.2V and 750V range.

Input Impedance: 10 MΩ and ≤50 pF on all ranges
Common Mode Noise Rejection: ≥60 dB dc to 60 Hz, 1kΩ unbalance
Overload Protection: 1000V dc, 750V rms ac
Response Time: ≤2 seconds to rated accuracy

DC Current

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
32 mA 320 mA	0.01 mA 0.1 mA	1.5% + 2 2% + 2	1.5% + 2 2% + 2
10A	10 mA	—	1.5% + 2

Voltage Burden: 0.2V on 32 mA range, 2.0V max. on 320 mA range, 0.5V on 10A range
Input Protection: Fluke 21, 630 mA/250V fuse in series with 3A/600V fuse in 300 mA input; Fluke 23, 630 mA/250V fuse in series 0.36Ω fusible resistor for mA input; 15A/600V fuse for 10A input
Response Time: ≤1 second to rated accuracy

AC Current (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
32 mA 320 mA	0.01 mA	3% + 2*	3% + 2*
10A	10 mA	-	1.5% + 2*

**45 Hz to 1 kHz*

Voltage Burden: 0.2V on 32 mA range, 2.0V max on 320 mA range, 0.5V on 10A range
Input Protection: Fluke 21, 630 mA/250V fuse in series with 3A/600V fuse in 300 mA input; Fluke 23, 630 mA/250V fuse in series 0.36Ω fusible resistor for mA input; 15A/600V fuse for 10A input
Response Time: ≤2 seconds to rated accuracy

Resistance

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
320Ω	0.1Ω	0.7% + 2	0.5% + 2
3200Ω 32 kΩ 320 kΩ 3.2 MΩ	1Ω 10Ω 100Ω 1 kΩ	0.7% + 1	0.5% + 1
32 MΩ	10 kΩ	2.5% + 1	2.0% + 1

Open Circuit Voltage: ≤3V
Full Scale Voltage: ≤440 mV on all ranges except ≤1.4V on 32 MΩ range
Input Protection: 500V dc or rms ac
Response Time: ≤1s up to 320 kΩ, ≤2s up to 3.2 MΩ, ≤10s up to 32 MΩ to rated accuracy

Continuity

Threshold: Approximately 150 ohms
Audible Tone: Continuous tone for continuity
Display: Less than .100 indicates continuity, OL (overload) indicates open-circuit, approximately 20,000 ohms or higher
Response Time: Approximately 100 ms

Diode Test

Test Current: Approximately 500 µA for a normal forward biased diode
Audible Tone: Brief tone for normal forward biased diode or semiconductor junction
Display: An indication of approximately .600 V for a normal forward biased silicon diode or semiconductor function and OL (overload) for a normal reverse biased diode or semiconductor junction
Response Time: Approximately 100ms

Analog Display

Measurement Rate: 23 measurements per second

Touch-Hold®

Fluke 23 only. Pushbutton activated mode. Automatically holds stable reading of voltage, resistance, or current indefinately even if test probe is removed. Reading updated by touching probe to other test points.

General Specifications

Max Common Mode Voltage: 1000V dc or peak ac
Temperature: 0°C to 50°C operating; -40°C to 60°C non-operating
Temperature Coefficient: 0.1 x specified accuracy per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C, ≤90% to 35°C except ≤80% using 32 MΩ range
Safety: Protection Class II per IEC 348, UL 1244 listed
Power: Single 9V battery, NEDA 1604 9V
Battery Life: More than 2000 hours (alkaline) or 1600 hours (carbon-zinc). "Sleep Mode" extends battery life when you forget to turn power off. Sleep mode activates after approximately 1 hour (5 min in diode test)
Size: 166 mm L x 75 mm W x 28 mm H (6.55 in x 2.95 in x 1.12 in)
Weight: 0.28 kg (0.63 lb)
Included: TL 70 Test Leads, manual, battery,, spare fuse (installed), and alligator clips.

Ordering Information

Models

January 1989 prices

Fluke 21 DMM w/ beeper, w/ 3-year warranty	$119
Fluke 23* DMM w/ Touch-Hold, w/ 3-year warranty	159

** Includes C70 Multipurpose Holster*

Accessories (Also see page 127)

TL20 Test Lead Set	35
TL70 Replacement Test Leads	8
Y8134 Deluxe Test and Lead Kit	22
Y8140 Test Lead Set	20
C50 Soft Carrying Case	15
C70 Multipurpose Holster	14
C100 Universal Carrying Case	30
83RF 100 MHz RF Probe	55
85RF 500 MHz RF.Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400* AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600* AC Current Probe	119
80i-1010 DC/AC Current Probe	229
LCA-10** Line Current Test Adapter	13

** LImited to ≤320A with Fluke 21*
***Fluke 23 Only*

Service & Support

Warranty

Three-year product warranty.See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)

25 & 27

LISTED
UL
1244

Fluke 25

MSHA
APPROVAL
2G-3665-0
PERMISSIBLE
MULTIMETER

LISTED
UL
1244

Fluke 27

MSHA
APPROVAL
2G-3665-0
PERMISSIBLE
MULTIMETER

Fluke 25 & 27 Analog/Digital & Rugged Multimeters

- Analog and digital display - tests changing or stable signals
- Easy to use, auto or manual range selection
- 2 year warranty
- Rugged "O" ring sealed case withstands harsh environments
- Superior EMI shielding
- -15° to 55°C operating range
- "Min-Max" Mode stores highest & lowest readings (27 only)
- "Relative Mode" displays only changes in readings (27 only)

Rugged

Plant maintenance electricians, field service technicians, electrical equipment installers, and outside equipment installers will find these instruments rugged, reliable, and easy to use while providing all the accuracy and features needed for almost any application.

Designed to meet military specification of MIL-STD-28800 for Style A, Class 2 Instruments, the Fluke 25 and 27 Analog/Digital Multimeters perform under the extremes of heat, cold, humidity, shock, electromagnetic interference, vibration, and downright abuse.

The Fluke 25 and 27 are built with cases twice as thick as any other DMM we build. The cases are waterproof to 3 feet of water for one hour, resist many industrial chemicals, and won't sustain a flame when put to the blow torch test.

Safety Protection

Electrical and safety protection exceeds the world's toughest safety standards.

Autoranging

With autoranging, you choose the function you want and the meter automatically selects the range with the greatest accuracy and resolution. Symbols on the liquid crystal display remind you what is being measured and the range of measurement.

Manual Range

Since repetitive go-no-go tests and peaking/dipping adjustments are more easily done using one range, the manual range function will prove a real boon to users making these tests frequently. Touching the pushbutton once prevents the meter from changing ranges. Pushing the button again changes the range, and holding the button down for a couple of seconds restores the "Autorange" function.

Audible Tones

A continuous audible tone provides a fast check for continuity of current paths having 150 ohms or less.

A brief tone indicates a voltage drop of about 0.6 volts, the normal forward bias for semiconductor devices.

Touch Hold®

Touch Hold® captures a reading and displays it from memory even after the probe has been removed from the circuit. As soon as the reading stabilizes, the meter makes a distinctive audible chirp and holds the reading. Touch Hold® reduces the chance of circuit damage when a probe slips and contacts two points at once because you can concentrate on touching the right test point and nothing else. Touch Hold® reduces the risk of electrical shock and also gives the user time to log the reading if needed or refer back to the reading before the next measurement.

Min/Max Mode

The 27 can be connected to store minimum and maximum values that will be stored in memory for an extended period, such as over a weekend: useful for monitoring in the absence of chart recorders.

Relative Mode

Often a technician will need to know how much one reading differs from another. By taking the first reading as a reference then pressing the "REL" button, the succeeding measurements will display only the deviation from the reference.

25 & 27

Specifications

Technical Specifications

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0 mV	100 µV	0.1% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ in parallel with <100 pF
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc 50 Hz or 60 Hz; ≤1kΩ unbalance
Overload Protection V: 1000V rms
Overload Protection mV: 500V rms
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Reso-lution	Accuracy: ±(% of Rdg + Digits)		
		40 Hz-2 kHz	2 kHz-10 kHz	10kHz-30 kHz
320.0 mV	100µV	0.5% + 3	2% + 3	4%+10
3.200V	1 mV			
32.00 mA	10 mV			
320.0V	100 mV			
1000V	1V	1% + 3	3% + 3	Not spec

Input Impedance: 10 MΩ in parallel with <100 pF
Common Mode Noise Rejection: ≥60 dB from dc to 60 Hz; ≤1kΩ unbalance
Overload Protection V ac: 1000V rms (10^7 volthertz max)
Overload Protection mV ac: 500V rms (10^7 volthertz max)
Response Time: ≤2 s to rated accuracy

DC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Typical Burden Voltage
320.0 µA	0.1 µA	0.75% + 2	0.5 mV/µA
3200 µA	1 µA		0.5 mV/µA
32.00 mA	0.01 mA		5.6 mV/mA
320.0 mA	0.1 mA		5.6 mV/mA
10.00A	0.01A		50 mV/A

Input Protection: µA/mA ranges, 630 mA/250V fuse in series with 3A/600V fuse; 10 amp range, 20A/600V fuse
Response Time: ≤2 s to rated accuracy

AC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Typical Burden Voltage
320.0 µA	0.1 µA	1.5% + 2*	0.5 mV/µA
3200 µA	1 µA		0.5 mV/µA
32.00 mA	0.01 mA		5.6 mV/mA
320.0 mA	0.1 mA		5.6 mV/mA
10.00A	0.01A		50 mV/A

**40 to 1000 Hz*

Overload Protection: Same as DC current
Response Time: ≤4s to rated accuracy

Resistance

Range	Resolution	Response Time	Accuracy ±(% of Rdg + Digits)
320.0Ω	0.1Ω	6s	0.3% + 2
3.200 kΩ	1Ω	2s	0.2% + 2
32.00 kΩ	10Ω		
320.0 kΩ	100Ω		
3.200MΩ	1 kΩ		
32.00 MΩ	10 kΩ	6s	1% + 1

Overload Protection: 500V rms
Open Circuit Test Voltage: <2.8V dc
Full Scale Voltage: Up to 3.2 MΩ <420 mV dc; 32 MΩ <1.3V dc

Conductance:

Measures up to 32.00 nS (to 100,000 MΩ) with 0.01 nS resolution accurate to ±1% + 10; full scale voltage <1.3V dc
Response Time: ≤6s to rated accuracy

Diode Test/Continuity Test

Overload Protection	Open Circuit Test Voltage	Typical Test Current	Display Voltage
500V rms	<3.3V dc	0.7 mA	0.0V
		0.5 mA	0.6V
		0.3 mA	1.2V
		0.1 mA	2.0V

General Specifications

MIN/MAX Mode (27 only): Records the digital display readings (updated twice per second)
Display: 3 1/2- digits 3200 counts autopolarity, autozero
Common Mode Voltage: 1000V between any terminal and earth ground
Shock, Vibration and Water Resistance: Per MIL-T-28800 Class 2 Style A
Temperature: Storage -55°C to 85°C; Operation -15°C to 55°C
Temperature Coefficient: 0.1 x (specified accuracy) per °C for temperatures <18°C or >28°C
Electro-Magnetic Interference (EMI): The 25 & 27 meet MIL-STD-461 for RS03 (radiated susceptibility to 1V/meter from 14 kHz to 1 GHz) and REO2 (radiated emissions).
Relative Humidity: 0% to 95% (0°C to 35°C) 0% to 70% (35°C to 55°C)
Power: Single 9V NEDA 1604 or 6F22 or 006P
Battery Life: >1000 hours typical
Battery Indicator: Symbol first diplayed when 60 hours of life remain
Safety: Protection Class II per IEC 348, ANSI C39.5, UL 1244 listed. Meets MIL-STD-810C, Method 511.1, Procedure/Explosive Atmosphere Test
Size: 56 mm H x 95 mm W x 203 mm L (2.2 in H x 3.75 in W x 8 in L)
Weight: 0.75 kg (1.6 lb)
C20 Case Size: 102 mm H x 152 mm W x 262 mm L (4 in H x 6 in W x 10.3 in L)
Note: Case is 13 in (330mm) L including handle
Warranty: 3 years; calibration guaranteed for one year
Includes: Battery installed, TL70 Test Leads, two insulated alligator clips, spare fuse, and Operator's manual

Available in dark umber (STD model) or yellow (YEL model).

Ordering Information

Models

January 1989 prices

Fluke 25 STD Multimeter	$199
Fluke 25 YEL Multimeter	199
Fluke 27* STD Multimeter	269
Fluke 27* YEL Multimeter	269

**With MIN/MAX storage and Relative Modes*

Accessories (Also see page 127)

TL20 Test Lead Set	35
TL70 Replacement Test Leads	8
Y8134 Deluxe Test Lead Kit	22
Y8140 Test Lead Set	20
C20 Hard Carrying Case	20
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83RF 100 mHz R. F. Probe	55
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80TK Thermocouple Module	65
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Y8100 DC/AC Current Probe	259
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80i-1010 DC/AC Current Probe	229
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Service & Support

Warranty

Two-year product warranty. See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)

80 Series

NEW

Fluke 83

NEW

Fluke 85

NEW

Fluke 87

Fluke 83 Analog/Digital

- 3-3/4 digit, 4000 counts
- 0.3% basic dc accuracy
- 43 segment analog bargraph
- Frequency & duty cycle
- Capacitance
- Touch Hold® & Relative
- 3 year warranty

Fluke 85 Analog/Digital

- 3-3/4 digit, 4000 counts
- 0.1% basic dc accuracy
- 43 segment analog bargraph
- Frequency & duty cycle
- Capacitance
- Touch Hold® & Relative
- 3 year warranty

Fluke 87 Analog/Digital

- 3-3/4 digit, 4000 counts
- 0.1% basic dc accuracy
- Analog pointer
- Frequency & duty cycle
- Capacitance
- Touch Hold® & Relative
- True RMS ac voltage & current
- 1 ms Peak MIN MAX
- 4-1/2 digit mode
- Back lit display
- 3 year warranty

The new Fluke 80 Series (83, 85, and 87) is a family of versatile analog/digital multimeters with an impressive range of capabilities, including frequency, duty cycle and capacitance measurement.

Designed for electronic as well as industrial applications, the 80 Series' durable construction and unique safety features ensure reliability and optimal performance in a variety of environmental settings.

MIN/MAX AVERAGE recording mode with Min Max Alert ™

Stores the highest, lowest, and average of all readings, allowing you to monitor a signal for seconds or days. Selectable response times allow you to specify the time required to sense changes. Min Max Alert™ gives an audible tone for readings above or below previous minimums or maximums.

Frequency, Duty Cycle and Capacitance Measurements

Fluke 80 Series meters have a counter for frequency measurements from 0.5 Hz to 200 kHz, and duty cycle measurements from 0.1% to 99.9% of cycle. All three meters measure capacitance from 10 pF to 5 µF. Larger value capacitors may be measured using the analog display in the resistance mode.

Input Alert and Overload Protection

Input Alert™ provides an audible warning when current jacks are used and a non-current function is selected. This reduces the risk of damage to the equipment being tested and to the meter. Fluke 80 Series meters also provide 1,000 volt input protection in both ohms and diode test.

Fast 3-3/4 digit, 4000 count digital display, high resolution analog display

Ensures greater accuracy and resolution. Digital display updates 4 times/second.

For changing or unstable signals, the 87 features a high-resolution analog pointer; the 83 and 85 use an analog bargraph. The 83 and 85 also feature Zoom Mode for higher resolution analog readings. Analog displays update 40 times per second.

4-1/2 digit mode, 1 ms peak hold, true rms, backlit display (87 only)

The Fluke 87 is a true-rms meter, and offers a 4-1/2 digit, 19,999 count high resolution mode, plus 1 ms peak hold. The backlit display assures readability in poorly lit settings. Light shuts itself off 68 seconds after the button is pressed, prolonging battery life.

Touch Hold™ and Relative Modes

Touch Hold captures the measurement, beeps and locks it on the digital display until you're ready to view it. It automatically updates with each new measurement.

The Relative Mode remembers a reading and shows the change (difference) between it and any readings that follow.

Rugged, Sealed Construction

Splash and dust proof case and a specially designed protective holster protects the meter even under harsh operating conditions. All units are sealed and EMI shielded.

Standard Equipment

Every meter comes packaged with a yellow protective holster complete with a Flex-Stand™, safety-designed test leads, 9V battery (installed), manual and operator guide.

Specifications

Technical Specifications

Basic electrical specifications are given as ± ([% of reading] + [number of least significant digits]) for the temperature range of 18°C to 28°C and relative humidity less than 90%, for one year after calibration.

DC Voltage

	83	85/87
Range	Accuracy: ±(% of Rdg+Digits)	
400.0 mV, 4.000V, 40.00V, 400.0V 1000V	0.3% + 1	0.1% + 1

Maximum Resolution: 0.1 mV in 400.0 mV range
Input Impedance: 10 MΩ (nominal), <100 pF
Normal Mode Rejection Ratio: >60 dB @ 50 Hz or 60 Hz
Common Mode Rejection Ratio: >120 dB @ dc, 50 Hz or 60 Hz
Overload Protection: 1000V rms

AC Voltage

ac V	83	85	87
50 Hz-60 Hz			
400.0 mV	±(1%+4)	±(0.5%+4)	±(0.7%+4)
4.000V, 40.00V, 400.0V	±(1%+3)	±(0.5%+2)	±(0.7%+2)
1000V	±(1%+3)	±(0.5%+2)	±(0.7%+2)
45 Hz-5 kHz			
400.0mV	±(1.5%+4)	±(1%+4)	±(1%+4)
4.000V, 40.00V, 400.0V	±(1.5%+3)	±(1%+2)	±(1%+4)
1000V	±(2.5%+3)	±(2%+2)	±(1%+4)**
5 kHz-20 kHz			
400.0mV	—	±(2%+4)	±(2%+4)**
4.000V, 40.00V, 400.0V	—	±(4%+4)	±(2%+4)**
1000V	—	unspecified	unspecified

***Add 16 counts below 10% of range*

Maximum Resolution: 0.1 mV in the 400.0 mV range
Conversion Type: 83/85 average, 87 True RMS
Input Impedance: 10 MΩ (nominal), 100 pF
Common Mode Rejection Ratio: >60 dB @ dc to 60 Hz
Overload Protection: 1000V rms

DC and AC Current (45 Hz to 2 kHz)

	83	85	87	Burden Voltage
AC Range	**Accuracy: ±(% of Rdg+Digits)**			
400.0µA, 4000µA	1.2%+2	0.6%+2	1.0%+2	100 µV/µA
40.00mA, 400.0mA	1.2%+2	0.6%+2	1.0%+2	1.5 mV/mA
4000mA, 10.00A*	1.2%+2	0.6%+2	1.0%+2	0.03 V/A
DC Range	**Accuracy: ±(% of Rdg+Digits)**			
400.0µA, 4000µA	0.4%+2	0.2%+2	0.2%+2	100 µV/µA
40.00mA, 400.0mA	0.4%+2	0.2%+2	0.2%+2	1.5 mV/mA
4000mA, 10.00A*	0.4%+2	0.2%+2	0.2%+2	0.03 V/A

**10A continuous, 20A for 30 seconds maximum*

Maximum Resolution: 0.1 µA in the 400 µA range
Overload Protection:
µA/mA Ranges: 1A 600V FAST fuse
Amp Range: 15A 600V FAST fuse

Ohms

Range	83	85/87
	Accuracy: ±(% of Rdg+Digits)	
400.0Ω, 4.000 kΩ, 40.00 kΩ 400.0 kΩ, 4.000 MΩ	0.4% + 1	0.2% + 1
40.00 MΩ 40.00 nS	1.0% + 3 1.0% + 10	1.0% + 3 1.0% + 10

Maximum Resolution: 0.1Ω in the 400.0Ω range
Overload Protection: 1000V rms for circuits <0.3A short circuit, 660V for high energy circuits
Full Scale Voltage: <450 mV dc up to 4.0 MΩ <1.3V dc for 40 MΩ or nS
Open Circuit Voltage: <1.3V

Frequency (0.5 Hz to 200 kHz, pulse width >2 µS)

Range	Accuracy: ±(% of Rdg+Digits)
199.99, 1999.9 19.999 kHz, 199.99 kHz	0.005% + 1
>200 kHz	Unspecified

Maximum Resolution: 0.01 Hz on the 199.99 Hz range
Duty Cycle: 0.0 to 99.9%
Accuracy: Within ±(0.05% per Hz + 0.1%) of full scale for a 5V logic family input on the 4V dc range; within ±((0.06 x voltage range/input range) x 100%) of full scale for sine wave inputs on ac voltage ranges

Capacitance

Range	Accuracy: ±(% of Rdg+Digits)*
5.00 nF	1.0% + 35**
0.0500 µF, 0.500 µF 5.00 µF	1.0% + 2

**Accuracy with film capacitors or better*
***±(1.0% + 2) if Relative mode is used for zero residual*

Maximum Resolution: 0.01 nF on the 5.00 nF range

Diode Test and Continuity

Diode Test Indication: Display voltage drop; 0.8 mA nominal test current at 0.6V; 3.0V full scale, accuracy:±(2.0% + 1)
Continuity Indication: Continuous audible tone for test resistance below 20Ω
Open Circuit Voltage: <3.9V dc
Overload Protection: 1000V rms for circuits <0.3A short circuit, 660V for high energy circuits.

Display

Digital: 4000 counts, updates 4 times per second
Analog: 43 segments, updates 40 times per second (for 83 and 8)
4 x 32 segments (equivalent to 128), updates 40/sec. (for 87)
Frequency: 19,999 counts, updates 3 times per second @ >10 Hz
Annunciators: u, m, n, k, M, V, A, F, S (siemens), Ω (ohms), Hz, AC, DC, MIN, MAX, RECORD, (AUTO autorange), (duty cycle), (hold), (low battery), (audible continuity), (relative),

General Specifications

Maximum voltage applied to any earth terminal: 1000V rms
Storage Temperature: - 40°C to 60°C
Operating Temperature: -20°C to 55°C
Temperature Coefficient: 0.05 x (specified accuracy) per °C (for temperatures <18°C or >28°C)
Relative Humidity: 0% to 90% (0°C to 35°C) 0% to 70% (35°C to 55°C)
Shock & Vibration: Per MIL-T-28800 for a Class 2 Instrument
Safety: Designed to Class II per IEC 348, ISA-DS82, and UL 1244
Power Requirements: Single 9V battery (NEDA 1604 or 6F22 or 006P)
Battery Life: 500 hours typical (alkaline). Battery symbol first displayed when at least 60 hours of battery life remain
Size: 1.25 in H x 3.41 in W x 7.35 in L (32 mm H x 87 mm W x 187mm L).
With holster and Flex-Stand:
2.06 in H x 3.86 in W x 7.93 in L (52 mm H x 98 mm W x 201 mm L)
Weight: 12.5 oz (0.36 kg). With holster and Flex-Stand 22.0 oz (0.62 kg)
Warranty: Three years parts and labor. One year calibration cycle

Ordering Information

Models

January 1989 prices

Fluke 83 Multimeter	$189
Fluke 85 Multimeter	219
Fluke 87 Multimeter	259

Accessories (Also see 127)

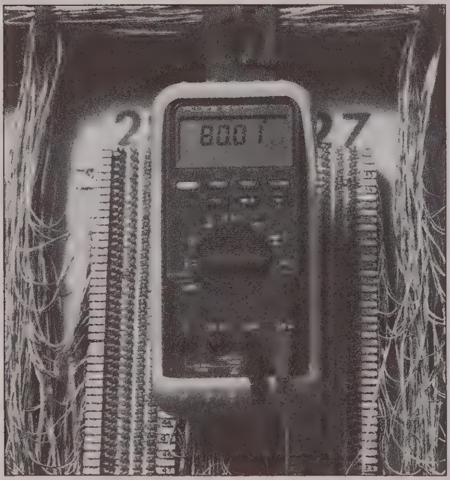
C81G Optional Grey Holster	14
C81Y Replacement Yellow Holster	14

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)



Protective Holster

FlexStand™

8025B

8025B

8025B Multimeter
Designed for MIL-T-28800 Type II, Class 2, Style A requirements
3-1/2 digit, 3200 count display
31 segment bar graph for peaking, nulling and capacitor checking
0.2% basic dc accuracy
Touch Hold® to capture and display readings
LCD symbols annunciate range and modes
Safety designed with extensive overload protection, non-metallic case, and bail
Rugged sealed construction keeps out dirt, water, and contaminants
Comes with C100 ruggedized hard case and low temperature test leads
-40 to 55°C operating range
One year calibration interval
Two year warranty
Fast autoranging or manual ranging
Range hold
Continuity/diode test beeper
1k ohm shunted stray-voltage test leads

Designed for use in harsh military environments, the 8025B offers the performance and accuracy of a digital multimeter with the speed and dynamic measurement capability of an analog meter. The 8025B offers bench instrument performance in a convenient hand-held package.

3200-Count Digital Display

The 8025B 3-1/2 digit (3200 count) display equals the resolution of a 4-1/2 digit meter for reading between 2 and 3.2, 20 and 32, or 2000 and 3200.

The analog bar graph allows quicker, easier testing for erratic or unstable signals. It updates ten times faster than the digital display.

Autoranging

Simplifies and speeds up the use of the meter. No need to decide what range to use or to wait for long range-changing delays. Manual ranging is also included.

Audible Continuity/Diode Test

Wiring, diode, and transistor checks can be done quickly without looking at the display.

Touch Hold®

You can take readings of critical circuitry while keeping your eyes on the probes and circuit. Using standard test leads, the 8025B captures your measurement, beeps, locks the reading in the display for viewing, and then automatically updates when a new measurement is taken.

Safety

Safety is designed in with extensive overload protection, high energy fuses, fused 10A range, non-metallic case and bail, recessed input jacks, safety-designed test leads, and no fuses to replace for voltage and resistance overloads.

Low Power Resistance

In-circuit resistance measurements can be made without turning on diodes or transistors.

Min/Max Mode

The 8025B can be connected to record minimum and maximum values that will be stored in memory for an extended period, such as over a weekend: useful for monitoring in the absence of chart recorders.

Relative Mode

Often a technician will need to know how much one reading differs from another. By taking the first reading as a reference then pressing the "REL" button, the succeeding measurements will display only the deviation from the reference.

8025B

Display

Liquid Crystal
Digital Display: 3200 counts plus polarity indication, updated 2 times per second
Analog Display: 31 segment bar graph plus polarity indication, updated 25 times per second
Annunciators: k, M, Ω (Ohms); (Hold); (low battery); (manual range); 3,30,300 (range indicators); nS (nanosiemens)

Specifications

Technical Specifications

Basic electrical specifications are defined for the temperature range of 18°C to 28°C and relative humidity up to 95%, for one year after calibration.
Low Temperature Operation: at -40°C LCD updates may take more than 6 seconds

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0 mV	100 µV	0.2% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ nominal
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc 50 Hz or 60 Hz; ≤1kΩ unbalance
Overload Protection V: 1000V rms; 500V rms on 320 mV range
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		
		40 Hz-2 kHz	2 kHz-10 kHz	10 kHz-30 kHz
320.0 mV	100 µV	0.5%+3	2% + 3	4%+10
3.200V	1 mV			
32.00V	10 mV			
320.0V	100 mV			
1000V	1V	1% + 3	3% + 3	Not Spec'd

Conversion Type: AC coupled, average sensing, calibrated to read rms value of sinewave
Input Impedance: 10 MΩ nominal in parallel with ≤100 pF
Common Mode Rejection Ratio: ≥60 dB, DC to 50 Hz; ≤1kΩ unbalance
Overload Protection: 1000V rms, 500V rms on 320 mV range; 10 volt-hertz maximum
Response Time: ≤2 s to rated accuracy

DC and AC Current

Range	Resolution	Typical Burden Voltage	Accuracy: ±(% of Rdg + Digits)	
			DC Accuracy	AC 40 Hz to 1 kHz
320.0 µA	0.1 µA	160 mV	0.75% +2	1.5% +2
3200 µA	1 µA	1.6		
32.00 mA	10 µV	180 mV		
320.0 mA	100 µA	1.8V		
10.00A	10 mA	0.5V		

Overload Protection: µA/mA ranges: 630 mA/250V fuse in series with 3A/600A fuse
Amp range: 20A/600V fuse

Resistance

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0Ω	0.1Ω	0.3% + 2
3.200k	1Ω	0.2% + 1
32.00k	10Ω	
320.0k	100Ω	
3.200M	1 kΩ	
32.00M	10 kΩ	1% + 1
32.00 nS	0.01 nS	2% + 10

Overload Protection: 500V rms
Full Scale Voltage: <420 mV up to 3.2 MΩ <1.3V up to 32 MΩ
Open Circuit Voltage: <2.8V (-15°C to 55°C)
Response Time: ≤6s to rated accuracy

Diode Test and Continuity

Diode Test Indication: Displays voltage drop; 0.5 mA nominal test current at 0.6V; 2.08V full scale
Continuity Indication: Continuous audible tone for test resistance below 150 ohms. Momentary tone for test voltage dropping below 0.7V (typical silicon diode threshold)
Open Circuit Voltage: <3.3V (-15°C to 55°C)
Overload Protection: 500V rms

General Specifications

MIN/MAX Mode: Records the digital display readings (updated twice per second)
Maximum Voltage to be applied to any terminal: 1000V with respect to earth ground
Power Requirements: Single 9V battery NEDA 1604. Lithium battery recommended for low temperature operation
Battery Life: 1000 hours typical. Battery symbol first displayed when at least 60 hours of battery life remain. Battery life shortens significantly at low temperature. Lithium battery recommended for low temperature operation.
Instrument Size: 56 mm H x 95 mm W x 203 mm L (2.2 in H x 3.75 in W x 8 in)
C100 Case Size: 121 mm H x 337 mm W x 394 mm L (4.75 in H x 13.25 in W x 15.5 L)
Weight: DMM alone is 0.75 kg (1.6 lb) with case and accessories 1.5 kg (3.2 lb)
Storage Temperature: -55°C to 85°C
Operating Temperature: -40°C to 55°C
Temperature Coefficient: 0.1 x applicable accuracy specification per °C (for temperatures <18°C or >28°C)
Electro-Magnetic Interference (EMI): The 8025B meet MIL-STD-461 for RS03 (to 1V/meter from 14 kHz to 1 GHz) and RE02
Shock, Vibration, Humidity and Water Resistance: Per MIL-T-28800 for a Style A, Class 2 instrument
Included: Battery, low temperature test leads, two insulated alligator clips, instruction manual, TL25B stray voltage test lead set, with a 1k ohm thermistor load for DMM input, and C100 ruggedized hard case

Ordering Information

Model

	January 1989 prices
8025B Multimeter	$364

Accessories (Also see page 127)

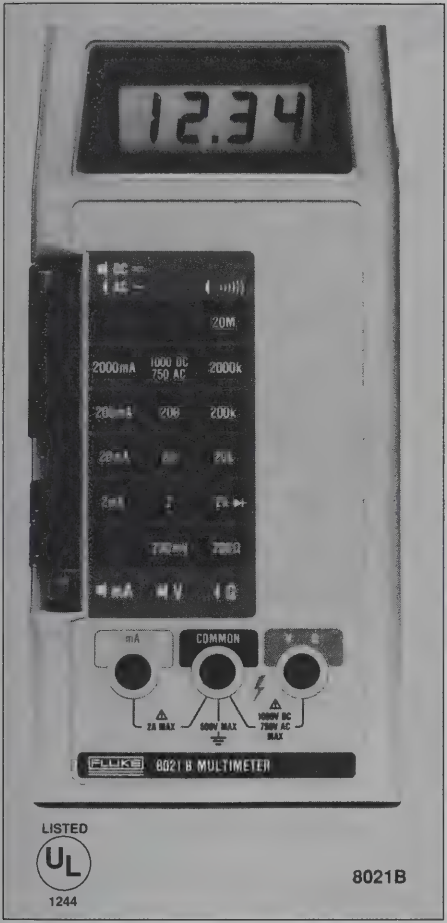
TL25B Stray Voltage Test Leads	45
Y8134 Deluxe Test Lead Kit	22
C25 Soft Carrying Case	20
83RF 100 MHz RF Probe	55
85RF 500 MHz RF Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
80 K-6 HV Probe	49
80 K-40 HV Probe	85
80J-10 Current Shunt	35
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400 AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600 AC Current Probe	119
80i-1010 DC/AC Current Probe	229
LCA-10 Line Current Test Adapter	13

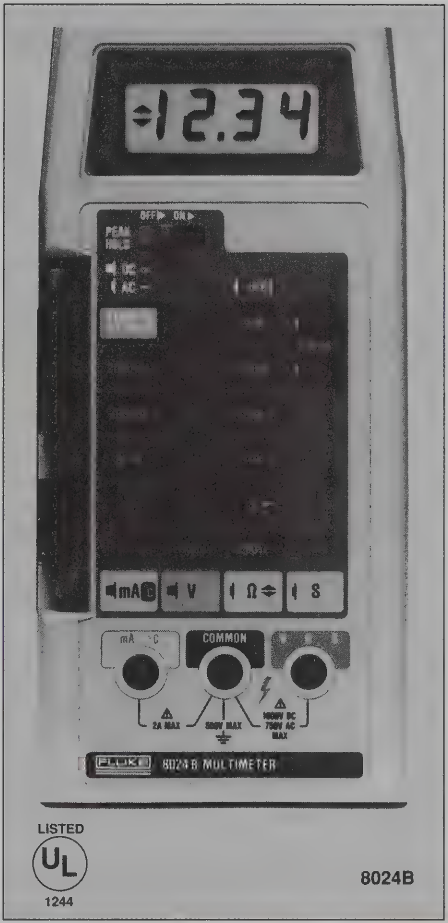
Service & Support

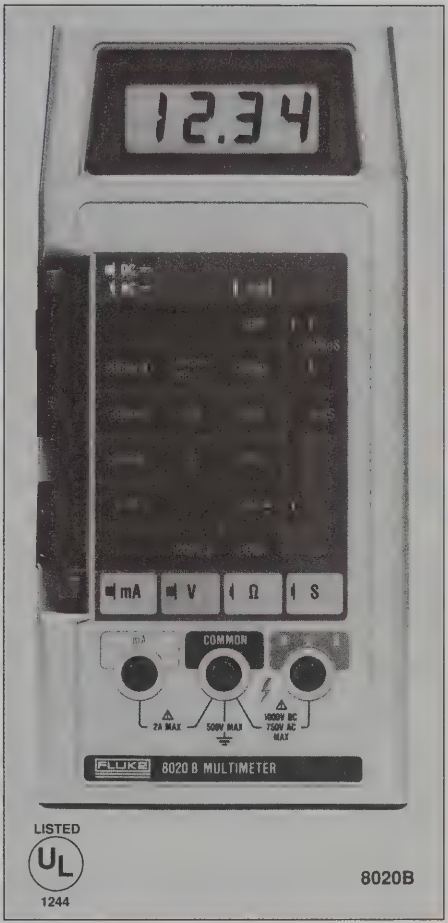
Warranty

Two-year product warranty. See page 470 for further information on warranty terms and conditions.

8020B, 8021B, 8024B & 8026B (B-Series)







8021B, Rugged & Economical

- 3-1/2 digits (2000 counts)
- Six functions including diode test
- High-speed audible continuity
- 0.25% basic dc accuracy
- 2-yr warranty, 2-yr calibration cycle
- Tilt bail with detent position
- Extensive overload protection
- UL 1244 listed
- Shock and vibration per MIL-T-28800, Class 5

8024B More than a DMM

- 3-1/2 digits (2000 counts)
- High speed audible continuity (50 µs response)
- Peak-hold (10 ms response)
- Temperature (with any K-type thermocouple)
- Logic level detection
- Conductance
- 0.1% basic dc accuracy
- 2-yr warranty, 2-yr calibration cycle
- Full overload protection
- Fast ac or dc transient capture
- Shock and vibration per MIL-T-22880, Class 5
- Tilt bail with detent position
- UL 1244 listed

8026B & 8020B Professional Precision

- 3-1/2 digits (2000 counts)
- All basic DMM functions
- Conductance
- Diode Test
- True rms (8026B only)
- 0.1% basic dc accuracy
- High-speed audible continuity testing
- Tilt bail with detent position
- Extensive overload protection
- UL 1244 listed
- Shock and vibration per MIL-T-22880, Class 5
- Two year warranty

8020B, 8021B, 8024B & 8026B (B-Series)

8021B

This rugged 3-1/2 digit handheld DMM was designed for the person who needs the following six basic measurement functions: dc and ac volts, dc and ac amps, ohms, and diode test.

Both electrical and mechanical features make the DMM the world's best in its class. For instance, the 8021B meets the vibration and shock test requirements for Class 5 instruments outlined in U.S. Military Specification MIL-T-28800. Overload protection circuits prevent damage to the instrument caused by accidental operator errors, including voltage input transients up to 6 kV. The current input has two in-series fuses, one for normal overload situations — a common 2A, 250V variety — and a second for high-energy fault conditions, like accidentally connecting the DMM to a 480V ac power line. A crystal-controlled oscillator gives the Fluke hand-held DMM the best 60 Hz or 50 Hz line noise rejection available in any hand-held DMM.

The simple front panel layout makes the DMM easy to use. A comprehensive owner's manual clearly explains the unit's operation, and typical measurement techniques are covered so you can get the most out of your DMM.

8024B

Designed with the field serice technician in mind, this instrument provides a unique combination of functions that reduces the number of tools needed for on-location repairs. Temperature capability (use any K thermocouple), peakhold (measure motor starting currents or line transients), and a logic level indicator in combination with features more commonly found on DMMs will make this multimeter an integral part of any customer service tool kit.

The 8024B, like all Fluke handheld DMMs, will withstand the rigors of field service. It is used around the world by people who demand exceptional performance, reliability, and ruggedness.

Peak-Hold

This function works for dc or ac voltage or current measurements and is for capturing transient dc peaks or ac surges. For dc, the most positive value will be displayed on the LCD, and peaks typically as short as 5 ms are captured. Average-sensing, rms-indicating techniques are used for ac for transients as short as 150 ms for 48 to 450 Hz waveforms. The decay rate of the display is less than one digit per second.

This feature is especially useful for measuring voltage pulses in electro-mechanical equipment or surge currents in electric motors. Currents as high as 1000 amps may be measured using the optional current probe 80i-1010 clamp-on ac/dc current probe.

Temperature

The 8024B directly displays temperature (in degrees Celsius) when used with optional K-type thermocouples. The input of the 8024B has a temperature-compensated reference junction.

Temperatures from -20°C to +1265°C can be measured depending on which of the following K-type thermocouples are used: the Y8102 is a sheathed probe, good to +925°C, for liquid immersion or penetration measurements; the Y8103 is a bead thermocouple, good to +260°C, for air or gas temperature measurements. The Y8104 is a termination kit for attaching any K-type thermocouple to the 8024B.

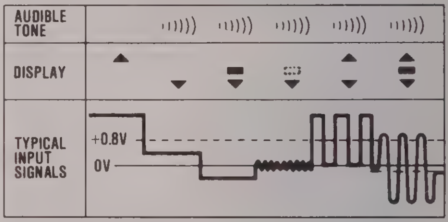
Now you can measure component heat rise, motor temperatures, heating and cooling equipment, etc.

Fluke's high-resolution semiconductor temperature probe, the 80T-150U, will also work with the 8024B as well as all other Fluke DMMs. It has better resolution and accuracy but covers a smaller temperature range (to +150°C or +302°F). The 80T-150U is suited for surface, air, and some liquid immersions.

Logic Level Detection

This function serves the same purpose as an oscilloscope or logic probe in detecting level transitions that last 50 microseconds or longer.

A pulse stretcher is used to detect low-duty cycle pulses .



8026B & 8020B

Both the 8026B and 8020B provide features that make them ideal for troubleshooting relays, cables, switches, and for locating intermittent shorts and opens. The 8026B and 8020B offer capabilities that allow you to check leakage current of diodes, cable insulation, connectors, printed circuit boards, etc.

The 8026B and 8020B are equipped with extensive internal protection against overloads, transients to 6 kV, or operator errors. The current input is protected with two in-series fuses —2A/250V and 3A/600V. In normal overload situations, only the common 2A/250V fuse will blow. The 3A/600V fuse will blow when accidentally attached to a source of more than 250 volts —like a 480-volt power line. Over 20% of the components are devoted exclusively to overload protection.

True RMS

Most ac meters are accurate only when measuring sinewaves. In modern electronic and electrical equipment, however, measurement errors on the order of 20% or more may result from radically non-sinusoidal waveforms such as squarewaves, pulses, or the outputs from silicon controlled rectifiers. True-rms sensing circuits such as found in the 8026B prevent such errors.

8020B, 8021B, 8024B & 8026B (B-Series)

Specifications

B-Series*

<table>
<tr><th></th><th>8021B 8020B 8024B</th><th>8026B</th></tr>
<tr><td colspan="3">DC Voltage</td></tr>
<tr><td>Accuracy*</td><td>200 mV, 2V 20V, 200V, 1000V ranges
Highest resolution 100 µV on 200 mV range.<table><tr><th>8021B</th><th>8020B</th><th>8024B</th></tr><tr><td>0.25% + 1</td><td>0.1% + 1</td><td>0.1% + 1</td></tr></table></td><td>200mV,2V,20V,200V, 1000V ranges
Highest resolution 100 µV on 299 mV range 0.1% + 1</td></tr>
<tr><td>Overload Protection</td><td>1000V dc or peak ac on all ranges except 200 mV (15 sec. max. above 300V dc or rms). 6 kV, 10 µsec pulses, maximum 5 pulses/sec.)</td><td>1000V dc or peak ac on all ranges except 200 mV (15 sec. max. above 300V dc or rms). (6 kV, 10 µsec pulses, maximum 5 pulses/sec.)</td></tr>
<tr><td>Input Impedance</td><td>10 MΩ</td><td>10 mΩ</td></tr>
<tr><td>NMRR</td><td>>60 dB (50 Hz, 60 Hz)</td><td>>60 dB (50 Hz, 60 Hz)</td></tr>
<tr><td>CMRR (kΩ unbalance)</td><td>>100 dB at dc 50 Hz, 60 Hz</td><td>>100 dB at dc 50 Hz, 60 Hz</td></tr>
<tr><td colspan="3">AC Voltage</td></tr>
<tr><td>Accuracy*</td><td><table><tr><th></th><th colspan="2">8021B</th><th colspan="2">8020B/8024B</th></tr><tr><th>Range</th><th>45 Hz to 450 Hz</th><th>45 Hz to 1 kHz</th><th>to 2 kHz</th><th>to 5 kHz</th></tr><tr><td>200 mV</td><td>1.0% + 3</td><td>0.75% + 2</td><td>1.5% + 3</td><td>5% + 5</td></tr><tr><td>2V</td><td>1.0% + 3</td><td>0.75% + 2</td><td>1.5% + 3</td><td>5% + 5</td></tr><tr><td>20V</td><td>1.0% + 3</td><td>0.75% + 2</td><td>1.5% + 3</td><td>5% + 5</td></tr><tr><td>200V</td><td>1.0% + 3</td><td>0.75% + 2</td><td>1.5% + 3</td><td>—</td></tr><tr><td>750 V</td><td>1.0% + 3</td><td>1.0 % + 2</td><td>—</td><td>—</td></tr></table></td><td>>5% of range<table><tr><th>Range</th><th>45 Hz-1 kHz</th><th>to 2 kHz</th><th>to 5 kHz</th><th>to10 kHz</th></tr><tr><td>200 mV</td><td>0.5%+2</td><td>0.5%+2</td><td>0.5%+2</td><td>2%+3</td></tr><tr><td>2V</td><td>0.5%+2</td><td>0.5%+2</td><td>1%+3</td><td>2%+3</td></tr><tr><td>20V</td><td>0.5%+2</td><td>0.5%+2</td><td>1%+3</td><td>2%+3</td></tr><tr><td>200V</td><td>0.5%+2</td><td>1%+2</td><td>—</td><td>—</td></tr><tr><td>750V</td><td>0.5%+2</td><td>—</td><td>—</td><td>—</td></tr></table></td></tr>
<tr><td>Overload Protection</td><td>750V ac, 100V dc on all range except 200 mV
(15 sec. max. above 300V rms)</td><td>750V ac, 100V dc on all range except 200 mV
(15 sec. max. above 300V rms)</td></tr>
<tr><td>Input Impedance</td><td>10 MΩ (<100 pF)</td><td>10 MΩ (<100 pF)</td></tr>
<tr><td>CMRR (1kΩ unbalance)</td><td><60 dB (50 Hz, 60 Hz)</td><td><60 dB (50 Hz, 60 Hz)</td></tr>
<tr><td>Crest Factor:</td><td>Does not apply</td><td>1:1 to 3:1</td></tr>
<tr><td>Conversion Type</td><td>Average sensing, calibrated to tread rms of sine wave.</td><td>True rms ac coupled</td></tr>
<tr><td colspan="3">Current</td></tr>
<tr><td>Accuracy (dc)*</td><td>Highest resolution 1 µA on 2 mA range<table><tr><th>Range</th><th>8021B</th><th>8020B</th><th>8024B</th></tr><tr><td>2 mA, 20 mA,200 mA, 2000 mA ranges</td><td>0.75% + 1</td><td>0.75% + 1</td><td>0.75% + 1</td></tr></table></td><td>Highest resolution 1 µA on 2 mA range<table><tr><td>2 ma, 20 mA, 200 mA, 2000 mA ranges</td><td>0.75% + 1</td></tr></table></td></tr>
<tr><td>Accuracy (ac)*</td><td><table><tr><td>2 mA (45-450 Hz)</td><td>3.0% + 3</td><td>3.0% + 2</td><td>4.0% + 2</td></tr><tr><td>20 mA, 200 mA, 2000 mA (45-450 Hz)</td><td>2.0% + 3</td><td>1.5% + 2</td><td>1.5% + 2</td></tr><tr><td>(to 1 kHz)</td><td>—</td><td>1.5% + 2</td><td>1.5% + 2</td></tr></table></td><td><table><tr><th>Range</th><th>45 Hz-450 Hz*</th><th>to 1 kHz*</th></tr><tr><td>2 mA</td><td>3.0% + 2</td><td>—</td></tr><tr><td>20 mA</td><td>1.5% + 2</td><td>1.5% + 2</td></tr><tr><td>200 mA</td><td>1.5% + 2</td><td>1.5% + 2</td></tr><tr><td>2000 mA</td><td>1.5% + 2</td><td>1.5% + 2</td></tr></table></td></tr>
<tr><td>Overload Protection</td><td>2A/250V fuse in series with 3A/600V fuse</td><td>2A/250V fuse in series with 3A/600V fuse</td></tr>
<tr><td>Burden Voltage</td><td><0.3V all ranges (<0.9V on 2000 mA)</td><td><0.3V all ranges (<0.9V on 2000 mA)</td></tr>
</table>

*True RMS ac coupled

8020B, 8021B, 8024B & 8026B (B-Series)

Specifications, continued

		8021B	8020B	8024B	8026B	
Resistance Conductance						
Accuracy	**Range**	**8021B**	**8020B**	**8024B**	**Range**	
	200Ω	0.3% + 3	0.2% + 3	0.2% + 3	200Ω	0.2% + 3
	2 kΩ to 200 kΩ	0.2% + 1	0.1% + 1	0.1% + 1	2 kΩ to 200 kΩ	0.1% + 3
	2000 kΩ	2.0% + 1	2.0% + 1	0.15% + 1	2000 kΩ, 20 MΩ	2.0% + 1
	20 MΩ	2.0% + 1	2.0% + 1	2.0% + 1	2 mS	0.2% + 1
	2 mS	—	0.2% + 1	—	200 nS	2.0% + 10
	200 nS	—	2.0% + 10	2.0% + 10		
	Lowest resolution 0.1Ω on 200Ω range				Highest resolution on 0.1Ω on 200Ω range	
Continuity beeper (typical threshold)		<600Ω	<600Ω	<600Ω	<600Ω	
Diode Test	Use 2 kΩ, 200 kΩ 20 MΩ range				Use 2 kΩ, 200 kΩ 20 MΩ range	
Overload Protection	500V rms (15 sec. max. above 300V)				500V rms (15 sec. max. above 300V)	
Open Circuit Voltage	<1.5V for all ranges (3.5V on 2 kΩ)				<1.5V for all ranges (3.5V on 2 kΩ)	
General						
Max. CM Voltage	500V with respect to earth ground				500V with respect to earth ground	
Display	3-1/2 digit LCD (1999 count)				3-1/2 digit LCD (1999 count)	
Temperature	Operating: 0°C to 50°C. Storage: -35°C to +60°C				Operating: 0°C to 50°C. Storage: -35°C to +60°C	
Humidity	0 to 90% (0°C to 35°C) (0 to 80%, 2 MΩ, 20 MΩ and 200 nS ranges) 0 to 70T (35°C to 50°C)				0 to 80% (0°C to 35°C) 0 to 70% (35°C to 50°C)	
Temperature Coefficient	0.1x specified accuracy/°C applies from 0°C to 18°C and from 28°C to 50°C				0.1x specified accuracy/°C applies from 0°C to 18°C and from 28°C to 50°C	
Shock & Vibration	Per MIL-T-28800C, Class 3				Per MIL-T-28800C, Class 3	
Power	Single 9V battery 200 hours (8021B, 8020B), 100 hours (8024B) (alkaline)				Single 9V battery 200 hours (alkaline)	
Size	45 mm H x 86 mm W x 180 mm L (1.8 in H x 3.4 in W x 7.1 in L)				45 mm H x 86 mm W x 180 mm L (1.8 in H x 3.4 in W x 7.1 in L)	
Weight	0.37 kg (13 oz), 8021B, 8020B, 0.48 kg (17 oz), 8024B				0.37 kg (13 oz)	
Calibration	2 years for specified accuracy				1 year for specified accuracy	
Warranty	2 years parts and labor				2 years parts and labor	
Special Functions	Display hold, peak hold, temperature, level detector, (8024B)					

**Accuracy specifications are ±(% of reading + number of digits). Accuracy specified for temperature range of 18°C to 28°C.*

Ordering Information

Models

January 1989 prices

8020B DMM w/ 2-year warranty	$259
8021B DMM w/ 2-year warranty	209
8024B DMM w/ 2-year warranty	299
8026B DMM w/ 2-year warranty	269

Accessories (Also see page 127)

TL20 Test Lead Set	35
Y8132 Test Lead Set	11
Y8134 Deluxe Test Lead Kit	22
Y8140 Test Lead Set	20
C90 Soft Case	$15
A81 Battery Eliminator	20
83RF 100mHz RF Probe	55
85RF 500 mHz RF Probe	85
80TK Thermocouple Module	65
80T-150U Temperature Probe	120
80 K-6 HV Probe	49
80 K-40 HV Probe	85
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400 AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600 AC Current Probe	119
80i-1010 DC/AC Current Probe	229

Service & Support

Warranty

Two-year product warranty. See page 470 for further information on warranty terms and conditions.

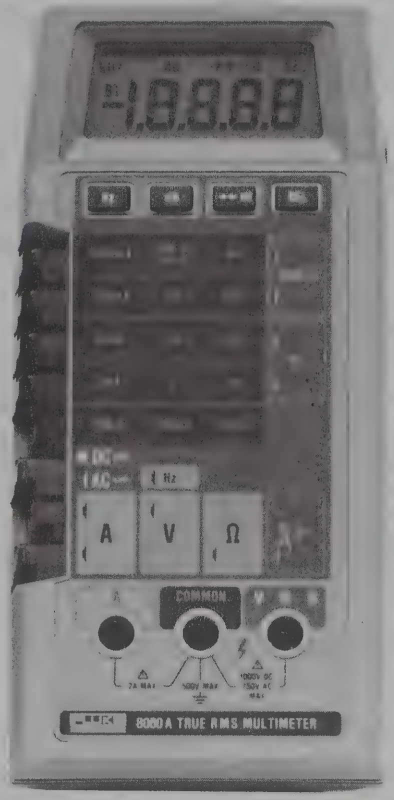
Available through Distributors (See page 500)

8060A & 8062A

(NSN 6625-01-160-4299) **8062A**

8062A 4-1/2 Digit DMM

- 4-1/2 digit (20,000 count) resolution
- True-rms ac measurements
- Fast audible/visual continuity tests
- Relative reference (offset)
- Low-power ohms all resistance ranges
- Constant-current diode test mode
- Measure resistances to 300 MΩ
- True-rms ac voltages to 30 kHz
- 0.05% basic dc accuracy
- Self diagnostics
- UL 1244 listed



(NSN 6625-01-157-2246) **8060A**

8060A 4-1/2 Digit DMM

- 4-1/2 digit (20,000 count) resolution
- True-rms ac measurements
- Fast audible/visual continuity tests
- Relative reference (offset)
- Low-power ohms all resistance ranges
- Constant-current diode test mode
- Measure resistances to 300 MΩ
- True-rms ac voltages to 100 kHz
- 0.04% basic dc accuracy
- Self diagnostics
- UL 1244 listed
- Plus
- *Frequency* Counter...12 Hz to 200 kHz
  - functional to 700 kHz
- dBm or relative dB measurements
- Conductance measurements

The 8060A and 8062A 4-1/2 digit handheld DMMs offer more measurement capabilities than found in most bench/portable models. They are Fluke's finest microcomputer-based handheld DMMs offering unique features never before found in a small low-cost DMM. The 8060A even measures *frequency*—from 12 Hz to more than 200 kHz—autoranging over four ranges from 200 Hz to 200 kHz.

At the touch of a single button you can select V, Hz, and dB.

Relative Reference

The microcomputer lets you automatically subtract lead resistance when measuring ohms and display only the difference between a stored reference value and a measured value. The relative mode is great for measuring changes, especially in dB and frequency measurements.

Overload Protected & Rugged

The 8060A and 8062A are well-suited to the needs of engineers and technicians skilled in audio, video, telecommunication, or computer technology. They have rugged cases, safety engineered jacks and test leads, double-fused current inputs, and extensive overload protection for all other functions and ranges.

Automatic MΩ Range Selection

To keep the front panel simple, there is only one manually-selectable position above 200 kΩ. When that position is used, the appropriate 2 MΩ, 20 MΩ, or 300 MΩ range is automatically selected.

Frequency Counter

It is easy to accurately measure the dB gain or loss of amplifiers, filters, attenuators, etc. with a DMM that has dB readout. To combine that feature in a handheld DMM that also measures *frequency* provides a nearly ideal test instrument for many applications. When you need the best in a handheld DMM, you should buy the 8060A. It has features you won't find even in most bench/portable DMMs.

True-rms AC

Because true-rms measurements of ac yield accurate results on non-sinusoidal waveforms as well as sinewaves, the 4-1/2 digit resolution,

8060A & 8062A

wide bandwidth, and exceptional accuracy of the 8060A and 8062A make them a superior tool for exacting technical people.

Special Functions

Several special annunciator symbols appear in the display as a reminder of what mode or modes have been selected when pushbuttons **A,B,C,** and **D** are used. Only pushbuttons **C** and **D** and corresponding functions appear on the 8062A.

(A) Pushing the Hz button when in the ac voltage mode selects the frequency function. The best of four ranges (200 Hz, 2 kHz, 20 kHz, and 200 kHz) is then automatically selected for frequencies between 12 Hz and 200 kHz. Readings are updated every 1.3 seconds or less even for low-frequency ranges.

(B) Pushing the dB button converts voltage readings to the equivalent in decibels. The reading may be relative to 1 milliwatt (dBm) and a 600 ohm load, or they may be relative to any level previously stored as a "relative reference."

(C) This pushbutton converts resistance measurements to fast indications of continuity, either audibly with a beep tone or quietly by the appearance of the solid black bar across the top of the display. Continuity as brief as 50 microseconds is enough to be recognized, stored, and indicated.

(D) When you first push the REL button it stores the displayed reading and subsequently subtracts that value from all subsequent readings for that measurement function. REL appears in the display as a reminder until the 8060A or 8062A is turned off or the pushbutton is pressed a second time.

Specifications

Technical Specifications

All accuracy specifications apply for one year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 80%, unless otherwise noted.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V,
Resolution: 10µV on the 200 mV range
Input Impedance: 10 MΩ on all ranges, >1000 MΩ selectable for 200 mV and 2V ranges
Accuracy: ±(% of Rdg + Digits)

Range	8060A	8062A
200 mV, 2V	0.04% + 2*	-0.05% + 2
20V, 200V, 1000V	0.05% + 2	0.07% + 2

**Accuracy ± (0.05 of reading + 2 digits) for > 1000 MΩ input impedance*

Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc, ≥90 dB at 50 Hz and 60 Hz, with 1 kΩ unbalance

Overload Protection: 1000V dc, 750V rms ac (not to exceed a volt-hertz product of 10^7) on all ranges, continuous except limited to 20 seconds on 200 mV and 2V ranges
Response Time: ≤1 second to rated accuracy

AC Voltage (True-RMS, AC Coupled)

Ranges: 200mV, 2V, 20V, 200V, 750V
Resolution: 10µV on the 200 mV range
Inmput Impedance: 10 MΩ, ≤100 pF (dBm mode also)
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Voltage Readout, 8060A: From 5% to 100% of Range

Range	Accuracy: ±(% of Rdg + Digits)					
	20 Hz	45 Hz	1 kHz	10 kHz	30 kHz	50 kHz 100 kHz
200 mV	1% + 10	0.2% +10	0.2% +20	0.5% +40	1%+ 100	3%+ 200
2V 20V 200V		0.5% +10	0.5% +20	1% +40	2% 100	
750V	Not Spec'd	1% +10	Not Specified			

Voltage Readout, 8062A: From 5% to 100% of Range

Range	Accuracy : ±(% of Rdg + Digits)			
	20 Hz	45 Hz	500 Hz 1 kHz	10 kHz 30 kHz
200 mV 2V	1% +10	0.5% +10	0.5% +20	1% +40
20V 200V			5% +20	5% +40
750V	Not spec	2% + 10		not Spec'd

dBm, 600Ω Reference, 8060A: From 5%to 100% of Range (-50 to +60 dBm)

Range	Accuracy in dB					
	20 Hz	45 Hz	1 kHz	10 kHz	30 kHz	50 kHz 100 kHz
2.45 mV-10.23 mV	±0.5	±1.0		±3.0	Not spec'd	
10.24 mV-19.99 mV	±0.2			±0.5	±1.0	±2.2
20 mV-199.99V	±0.15			±0.3	±0.65	±1.2
200V-750V	±0.5		Not spec'd			

Useful Frequency Range: -3 dB at 420 kHz at 100% of range, 220 kHz at 5% of range, typical
Common Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc or peak ac, 750V rms ac (not to exceed a volt-hertz product of 10^7) on all ranges, continuous, except 300V dc or rms ac on the 200 mV and 2V ranges for 20 seconds maximum
Response Time: ≤5 seconds to rated accuracy, any range

DC Current

Range	Resolution	Accuracy: ±(% Rdg + Digits) 8060A	Accuracy: ±(% Rdg + Digits) 8062A	Burden Voltage
200 µA 2 mA	0.01 µA 0.1 µA	0.2% + 2	0.3% + 2	≤0.3V
20 mA	1 µA	0.3% + 2		
200 mA	10 µA		0.7% + 2	
2000 mA	100 µA			≤0.9V

Input Protection: 2A/250V fuse in series with 3A/600V fuse
Response Time: ≤1 second to rated accuracy

AC Current (True-RMS)

Has dc-coupled current path, ac-coupled voltage-sensing circuits
Ranges, Resolution, Burden Voltage: Same as for dc current
Accuracy, 8060A: ±(% of Rdg + Digits) From 5% to 100% of range

Range	20 Hz-45 Hz	45 Hz-3 kHz	3 kHz-10 kHz	10 kHz-30kHz
200 µA 2 mA 20 mA	1% +10	0.75% +10	2% +20	2% +40
200 mA				
2000 mA			Not Specified	

Accuracy, 8062A: ±(% of Rdg + Digits) From 5% to 100% of range

Range	20 Hz-45 Hz	45 Hz-3 kHz	3 k 10 kHz	10 kHz-30 kHz
200 µA 2 mA 20 mA	1% +10	0.75% +10	2% +20	2% +40
200 mA	1.5% +10	1% +10		
2000 mA			Not Specified	

Crest Factor: 1:1 to 3:1
Response Time: ≤5 seconds to rated accuracy

Resistance

Ranges: 200Ω, 2Ω, 20 kΩ, and 200 kΩ manually selected plus 2 MΩ, 20 MΩ, 100 MΩ, and 300 MΩ automatically selected in the MΩ range

Resolution and Accuracy

Range	Resolution	Accuracy: ±(% of Rdg + Digits) 8060A	Accuracy: ±(% of Rdg + Digits) 8062A
200Ω	0.01Ω	0.07% + 2 + 0.02Ω	0.1% + 2 + 0.02Ω
2 kΩ 20 kΩ 200 kΩ	0.1Ω 1Ω 10Ω	0.07% + 2	0.1% + 2
2 MΩ* 20 MΩ* 100MΩ* 300 MΩ*	100Ω 10 kΩ 100 kΩ 1 MΩ	0.15% + 2 0.2% + 3 1% + 3 2% + 3	0.2% + 2 0.25% + 3 1% + 3 2% + 3

**These four autoranging MΩ ranges have a high enough source voltage to turn on a silicon junction.*

Open Circuit Voltage: ≤2.5V all ranges, except ≤4.8V on 200Ω range
Overload Protection: 500V dc or rms ac on all ranges
Response Time: ≤2 seconds to rated accuracy except ≤8 seconds on mΩ ranges

Continuity

Ranges: All resistance ranges
Threshold: For 8060A, ≤10% of any range used through 200 kΩ range and ≤20 kΩ above 200 kΩ range. For 8062A ≤50% of range and nominally <100 kΩ above 200 kΩ range
Indication: Horizontal bar in display, plus audible tone when desired
Response Time: ≤50 µs continuity, ≥200 ms indication

Diode Test

The diode test function displays the voltage-drop across a simiconductor junction using a 1 mA (± 10%) constant current supply and a 2V range. All resistance ranges up to and including the 200 KΩ range have less than enough source voltage to forward-bias a semiconductor junction, so that they can be used for in-circuit measurements
Reading Accuracy: ±(0.05% + 2 digits) for 8060A, ±(0.06% + 2 digits) for 8062A
Overload Protection: 500V dc or rms ac
Response Time: ≤2 seconds to rated accuracy

Conductance (8060A only)

Range: 200 nS (equivalent to 500 kΩ)
Resolution: 0.1 nS
Accuracy: (0.5% of reading + 20 digits)
Overload Protection: 500V dc or rms ac

Relative Reference

When the REL button is pushed the displayed reading is stored as a reference and subtracted from subsequent readings to indicate the amount of deviation.
Accuracy: Error will not exceed the sum of the errors of the reference reading and subsequent readings

Frequency (8060A only)

Ranges: 200 Hz, 2000Hz,20 kHz, and 200 kHz, automatically selected in the Hz mode, ac voltage function. Measures down to 12 Hz. Will measure to 700 kHz in Extended Frequency Mode
Resolution: 0.005% of range, e.g:, 0.01 Hz in 200 Hz range
Accuracy: ±(0.05% of reading + 1 digit)
Input Inpedance: Ac coupled into 10 MΩ, 100 pF
Sensitivity: For sinewaves, ≥10% of voltage range to 20 kHz, ≥25% of voltage range to 100 kHz, ≥75% of voltage range to 200 kHz
Response Time: ≤1 second above 16 Hz, ≤1.3 seconds from 12.2 Hz to 16 Hz, to rated accuracy

General Specifications

Calibration Cycle: One-year for specified accuracy
Display: 4 1/2 digits (20,000 counts), LCD, autozero, autopolarity, low battery (BT) indicator
Max. Common Mode Voltage: 500V dc or rms ac
Temperature: 0°C to 50°C operating; -35°C to 60°C non-operating
Temperature Coefficient: ≤0.1 times the applicable accuracy specification per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤80% to 35°C but ≤70% when measuring reisistance above 20 MΩ
Shock and Vibration: Per MIL-T-28800, Class 5
Safety: UL 1244 listed
Power: Single 9V battery, NEDA 1604, typically 170 hours of operation with alkaline type
Size: 180 mm L x 86 mm W x 45 mm H (7.1 in x 3.4 in x 1.8 in)
Weight: 0.41 kg (0.90 lb)
Included: Manual, TL70 test leads, 9V battery, operator's card, spare fuse

Ordering Information

Models

	January 1989 prices
8060A DMM, measures frequency	$389
8062A DMM	329

Accessories (Also see page 127)

TL20 Test Lead Set	35
TL70 Replacement Test Lead Set	8
Y8132 Test Lead Set	11
Y8134 Deluxe Test Lead Kit	22
Y8140 Test Lead Set	20
C25 Ruggedized Soft Case	20
C90 Soft Carrying Case	15
C100 Universal Carrying Case	30
A81 Battery Eliminator	20
83RF 100 mHz RF Probe	55
85RF 500 mHz RF Probe	85
80TK Termocouple Module	65
80T-150U Temperature Probe	120
80K-6 High Voltage Probe	49
80K-40 High Voltage Probe	85
80J-10 Current Shunt	35
Y8100 DC/AC Current Probe	259
Y8101 AC Current Probe	69
80i-400 AC Current Probe	69
80i-410 DC/AC Current Probe	129
80i-600 AC Current Probe	119
80i-1010 Dc/AC Current Probe	229
80i-kW Current/Power Probe	395

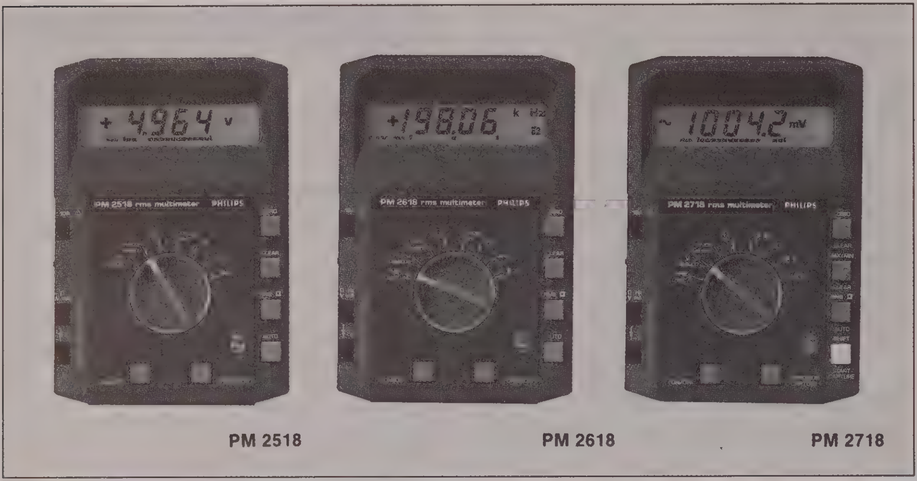
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)

PM 2518, PM 2618, PM 2718 (Series 18)


+4.964 v
PM 2518 rms multimeter PHILIPS
+198.06 kHz
PM 2618 rms multimeter PHILIPS
~1004.2 mV
PM 2718 rms multimeter PHILIPS

PM 2518 **PM 2618** **PM 2718**

Series 18 Handheld Multimeters

- High resolution analog bargraph
- Logic measurements to 10 MHz
- Frequency measurements to 200 kHz
- Min/Max and data hold
- mAs option for medical applications
- Electronic closed case calibration
- 750V ohms protection
- 0.1%, 0.07% and 0.04% basic accuracy with backlight LCD

These Series 18 DMMs are portable and compact, convenient for use in the laboratory or field, with all the performance and features expected of benchtop instruments.

The range of three models allows you to select exactly the functions you need for your application and environment, from general purpose testing, through communications and digital measurements, right up to R&D. Series 18 DMMs offer an excellent combination of value, convenience and performance.

High Accuracy Display

The 4+ digit display permits fast, high resolution measurements to be made on all functions. For example, 5V is measured to the nearest millivolt, with an accuracy of 0.1% or better.

AC True rms Values, Accurate up to 100 kHz

The new Series 18 DMMs have a custom true rms converter that guarantees accurate measurements on all ac signals (AC coupled). The following table compares the readings given for various input waves for the Series 18 meters and standard averaging instruments

Signal Form	∿	⎍	∧	⌇
RMS value	5V	5V	5V	5V
Reading on new Series 18 % error	5V 0	5V 0	5V 0	5V 0
Reading on averaging meter % error	5V 0	5.55V 11	4.7V 6	3.2V 36

750V Protection for Reliability

With standard 750V ohms input protection on all except current ranges, these new meters are amongst the best protected handheld instruments against accidental overload.

They can be connected to three-phase power supplies and the function switch can be rotated through the ohms range without damaging the meter.

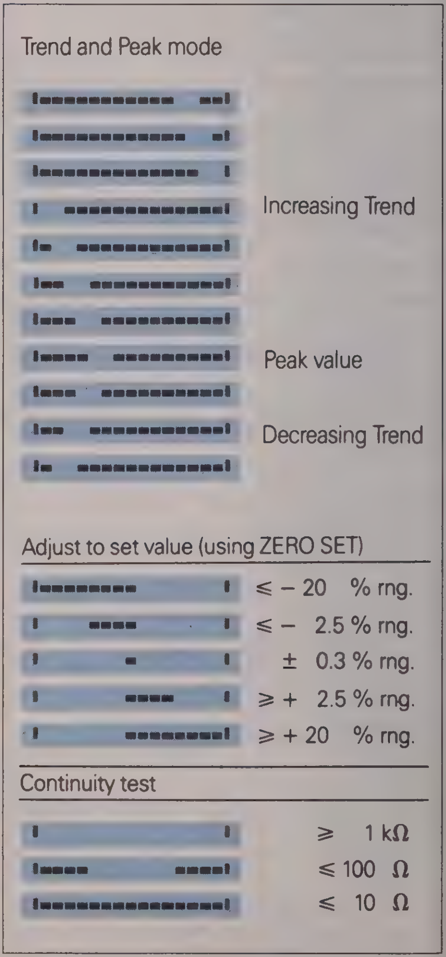
Standard dc and ac voltage range is 1 kV, protected to withstand 2.5 kV spikes, ensuring that these meters are not damaged in tough measuring conditions.

Bargraph Display

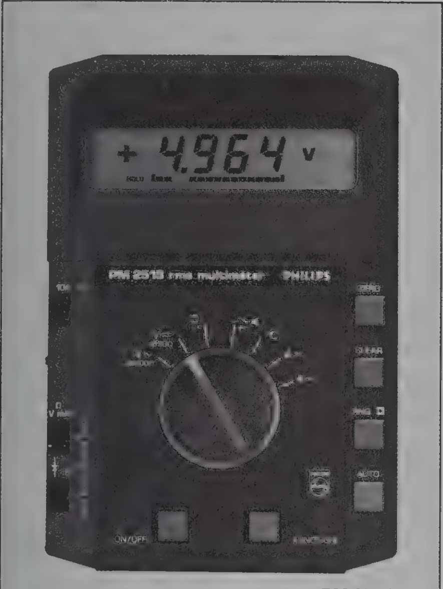
In checking signal trends or looking for peak values, the new Series 18 bargraph display is a step forward over conventional analog pointer systems. For example, as long as the input signal is increasing, the rotating bargraph moves to the right. When autoranging of the digital display value occurs, the bargraph continues to move to the right, always giving a clear indication of the signal trend, even when the signal crosses meter ranges.

For accurate detection of peak values, for example when tuning communication equipment, the bargraph has a maximum resolution equivalent to 8 counts on the digital display, or 0.08% of an analog scale.

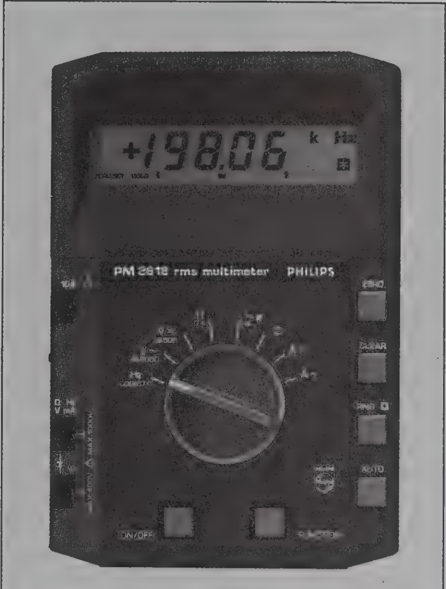
For adjustment to set values, the ZERO SET mode of the new Series 18 meters allows the bargraph to function as a highly sensitive minus-null-plus indicator. This allows accurate analog-indicated settings to any value within the meter's measuring range to an accuracy of 0.3%. Continuity testing not only gives an audible warning, but also a visual indication on the bargraph display.



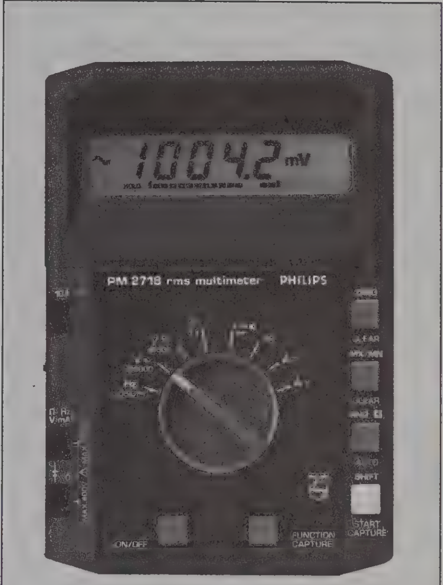
PM 2518, PM 2618, PM 2718 (Series 18)



PM 2518



PM 2618



PM 2718

PM 2518

- AC True rms (AC coupled)
- 750V ohms protection
- Analog bargraph
- Closed-case calibration
- Relative measurements
- dB measurements
- Temperature measurements
- 0.1% dc accuracy
- 40 kHz range

PM 2618

All PM 2518 features plus ...
- 0.07% dc accuracy
- 70 kHz AC range
- 200 kHz counter
- 10 MHz logic detection
- mAs option

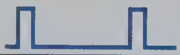
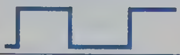
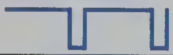
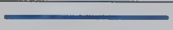
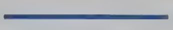
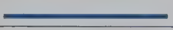
PM 2718

All PM 2618 features plus ...
- 0.04% dc accuracy
- 100 kHz ac range
- Min/Max. measurements
- Data capture and hold

10 MHz LOGIC Detection (PM 2618 and PM 2718 only)

Digital signal activity at speeds of more than 10 MHz can be meaningfully indicated by the LOGIC function. This allows not only high, low, bad or pulsed logic levels to be detected, but also gives an indication of the duty cycle at the measured point. The ability to distinguish between bad levels and real open circuits considerably reduces troubleshooting time.

At 'any logic', compatibility is simply achieved by connecting the measuring leads to the low and Vcc levels in the circuit to be tested, and pressing the ZERO button. The thresholds for the LOGIC mode are then set to 25% (low) and 75% (high) of this value, thereby covering the full range of logic levels — from low-power CMOS to industrial hardwired logic.

INPUT	DISPLAY
	HOLD _ n _ _ PROBE
	HOLD nnnn PROBE
	HOLD ‾ u ‾ ‾ PROBE
	‾ ‾ ‾ ‾ HOLD PROBE
	HOLD bAd PROBE
	HOLD - - - - PROBE
open circuit	HOLD OPEN PROBE

mAs Version (PM 2618 only)

Where milliamp second measurements are required, for example in medical environments, a special PM 2618 version allows these to be made in addition to any other standard functions. A single switch allows selection of mA, mAs measure or mAs zero. Measurement of pulses from 0.5 ms to 1 s in the range 10 uAs to 20 As ensures compatibility with current and future X-ray systems and scanners. This special version also includes the backlight display, with automatic on/off switching depending on the ambient light level.

Resistance Measurements from Short Circuit to 100 Mohm

Fast circuit-continuity checks are possible with a beeper that gives an instant warning of short-circuits, while resistance values from 100 mohm to 100 Mohm are displayed clearly and with optimum resolution via the autoranging.

PM 2518, PM 2618, PM 2718 (Series 18)

Function	Meter Ranges	Resolution	Accuracy (% reading = % range)			Input charac-teristics	Response time	Overload protection	Notes
			PM 2518	PM 2618	PM 2718				
Vdc	1V 10V 100V 1000V	100µV 1mV 10 mV 100 mV	0.1 + 0.02 0.1 + 0.02 0.1 + 0.02 0.1 + 0.02	0.07 + 0.02 0.07 + 0.02 0.07 + 0.02 0.07 + 0.02	0.04 + 0.02 0.04 + 0.02 0.04 + 0.02 0.04 + 0.02	10 MΩ 10 MΩ 9.1 MΩ 9.1 MΩ	Manual < 1s Auto < 1.5S	1000 Vrms 2.5 kV spike	
Vac (ac. coupled, True RMS, crest factor 2)	1V 10V 100V 1000V	100 µV 1 mV 100V 1000V	40 Hz to 3 kHz 0.5 + 0.1 3 kHz-40 kHz per kHz 0.20 + 0.05	40 Hz to 3 kHz 0.4 + 0.1 3 kHz-10 kHz per kHz 0.15 + 0.03	40 Hz to 3 kHz 0.3 + 0.1 3 kHz-100 kHz per kHz 0.1 + 0.03	>2 MΩ <20 pF	Manual <1s Auto <1.5s	1000 Vrms 2.5 kV spike	
Idc	20 mZ 200 mA 2A 10A(20A<20s)	10 µA 100 µA 1 mA 10 mA	0.5 + 0.1 0.5 + 0.1 0.5 + 0.1 0.5 + 0.1	0.4 + 0.1 0.4 + 0.1 0.4 + 0.1 0.4 + 0.1	0.4 + 0.1 0.4 + 0.1 0.4 + 0.1 0.4 + 0.1	<25 mV drop <250 mV drop <25 mV drop <250 mV drop	Manual <1s Auto <1.5s	20 mA and 200 mA ranges fuse protected	Voltage drop excludes fuse on 20 mA and 200 mA ranges
Iac (ac coupled True RMS, crest factor 9)	20 mA 200 mA 2A 10A(20A<20s)	10 µA 100 µA 1 mA 10 mA	0.8 + 0.1 40 Hz-400 Hz	0.8+ 0.1 40 Hz-400 Hz	0.6 + 0.1 40 Hz-400 Hz	Voltage drop as Idc	Manual <1s Auto <2	as Idc	as Idc
R	1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MQ 100 MΩ	100 mΩ 1Ω 10Ω 100 Ω 1 kΩ 100 kΩ	0.3 + 0.1 0.3 + 0.1 0.3 + 0.1 0.3 + 0.1 0.5 + 0.1 5 + 3	0.2 + 0.1 0.2 + 0.1 0.2 + 0.1 0.2 + 0.1 0.4 + 0.1 5 + 3	0.15 + 0.05 0.15 + 0.05 0.15 + 0.05 0.15 + 0.05 0.3 + 0.1 5 + 3	1 mA drive 100 µA drive 10 µA drive 1 µA drive 100 nA drive 10 nA drive	Manual <1s Auto <3s 10s	750V	Open input Voltage 3V 100 MΩ Manual ranging
Hz PM 2618 and PM 2718 only	20 kHz 200 kHz	1 Hz 10 Hz	N.A, N.A.	0.1 + 0.01 0.1 + 00.1	0.1 + 0.01 0.1 + 0.01	≤1 Vpp sensitivity 2 MΩ//3pF			10 Hz lower limit Gate time 1s
°C via Pt 100 100Ω RTD	-250°C to + 1000°C	0.1•C	1°C in range -20 to + 100°C	1°C in range -20 to 100°C	1°C in range -20 to + 100°C	1 mA drive current	dependent on probe		PM 9249 range -60°C to +200°C
Diode Test	1 Vdc	100 µV	0.3 + 0.1	0.3 + 0.1	0.3 + 0.1	1 mA drive	<1s	750V pk	
Continuity Test	1 kΩ	100 MΩ	0.5 + 0.1	0.5 + 0.1	0.5 + 0.1	1 mA drive	<0.2s	750V pk	Beeper
dB Vac	-51 dB to + 43 dB	0.1dB(>100 mV) 1 dB (<100 mV)	as Vac	as Vac	as Vac	Referenced to 1 mW 600Ω	as Vac	as Vac	
dB Vdc	-47 dB to +53.8 dB	0.1 dB(>10 mV) 1 dB (<10 mV)	±0.1dB(>10mV) ±1dB(<10mV)	±0.1dB(>10mV) ±1dB(<10mV)	±0.1dB(>10mV) ±1dB(<10mV)	Referenced to 1 mW 50Ω	as Vdc	as Vdc	1 mW 50Ω

Easy to Read in the Dark

Where measurements have to be made under poor lighting conditions, for example among tightly packed equipment or in out-of-the-way areas, special backlight versions of the new Series 18 DMMs have a display light that switches on automatically. If no new measurement is made, the backlight switches off after a short period to conserve battery life. Complete power-down of the instrument takes place after 30 minutes on both standard and backlit versions. Combined with low power consumption in normal use, this contributes to a battery lifetime of hundreds of hours.

Direct Temperature Readings

The optional PM 9249 Platinum RTD 100 probe gives direct temperature readings from -60 to +200°C, with a resolution of 0.1°C for air, liquid or surface temperatures.

Direct Gain and Loss Measurements

Measurements on amplifiers or communications equipment frequently require the conversion of readings into dB values. This is available with a single button operation on the Series 18, to a resolution of 0.1 dB and eliminating the need for separate calculations.

Relative Reference Values

Measurements of tolerances or component deviations from specified values are simple with the Series 18. A reference relative value can be set using the ZERO button, so the user does not always have to make the measurement relative to zero and calculate the deviation. Measurements are then made automatically, relative to that reference value.

200 kHz Frequency Counter Function (PM 2618, PM 2718 only)

A fully automatic counter function works at frequencies from 1 Hz to 200 kHz. Read-out is direct, with a scale indication showing Hz or kHz. It is highly sensitive, making it suitable for audio applications.

MIN/MAX Read-Out (PM 2718 only)

To monitor minimum and maximum levels in test set-ups, all the user has to do is connect the PM 2718 and leave it to measure. Minimum and maximum readings can be recalled and displayed at any time; and maximum and minimum readings of low-frequency signals (±1 Hz) can be measured and read within a few seconds.

Data Capture and Hold

PM 2718's data capture function allows a measured value to be frozen on the display, essential when working in situations where access to the measurement point is difficult. PM 2718 offers this as standard and it is optionally available on all Series 18 instruments with the data hold probe PM 9267. The user simply connects the measuring leads, waits for the "beeper" to confirm that the measurement has been acquired, and it can be read whenever it is needed.

Closed-Case Calibration

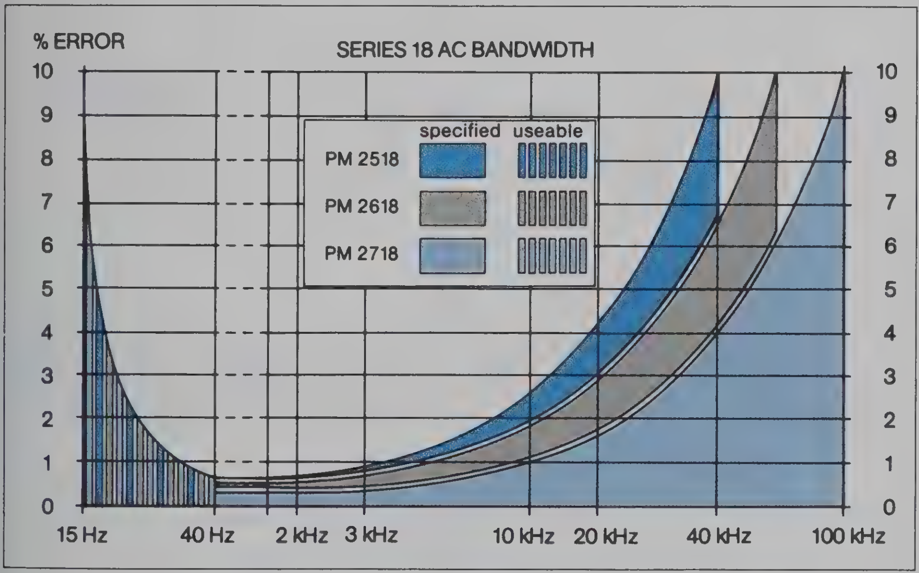
The new Series 18 DMMs are the first compact battery-powered units to offer closed-case calibration, a facility normally found only on much more expensive instruments. This facility allows savings in calibration time and cost and ensures error-free calibration.

The instruments can be recalibrated without opening the case by connection of an appropriate standard and switching the unit to "CAL" mode. For volume users recalibration is possible in an automated system environment. The optional PM 9181 GPIB interface speeds calibration by enabling these meters to be triggered, ranged, read and recalibrated over the IEEE 488 standard bus.

Specifications

General

Display: LCD, 12mm height with range and message characters
ADC System: Delta modulation, auto-zeroing, 11,000 counts
Reading Rate: 2.5 measurements/s
CMMR DC: >100 dB
CMMR 50/60 Hz: >80 dB
SMMR 50/60 Hz: >60 dB
Ranging: Fully automatic except 100 MΩ
Range Selection: Auto-range up at 110% of fs; Auto-range down at 10% of fs; Manual ranging by key
Overload: Indicated by OL on display
Underload (dB): Indicated by UL on display
Crest Factor Overload: Indicated by on display
High Voltage 110V: Indicated by on display
Max. V x Hz: 10^7
Reference Conditions: 23°C ± 2°C, RH 20... 80%, dewpoint 28°C



Logic Function (PM 2618 and PM 2718 only)

Vcc of test unit entered by use of ZERO key on meter
Default Vcc: 3.2V (gives 0.8V and 2.4V)
Logical 0 Level:≤0.25Vcc
Logical 1 Level:≥0.75Vcc
Threshold Resolution: ±50mV
Max. Vcc: 100V
Min. Pulse Duration: 100 ns using 1:1 probe
Max Frequency: 10 MHz using 1:1 probe
Beeper Function: On/Off via FUNCTION key; Low tone for logical 0. High tone for logical 1; intermittent high tone for pulse

Relative Measurement (using ZERO button)

Applicable Functions: All
Set Reference: On pushing ZERO button; last displayed value is used as reference
Recall Reference: By pushing and holding ZERO
Clear Reference: By key combination or Auto range selection

BEEPER Functions

PM 2518 and PM 2618: Dual tone selectable for ohms; Low ≤10%, high ≤continuity; Low ≤10%, high ≤1% logic; see logic function
PM 2718: As PM 2618 plus data captured indication

Environmental Conditions

Reference Temperature: 23°C ± 1°C
Rated Range of Use: 0...+45°C
Operating Range of Use: -10...+55°C
Storage & Transport: -40...+70°C
Limits of Humidity for Operation: 20...80%
Max Dew Point: +28°C
Calibration Interval: 1 year
Power Supply: 4 x R14 batteries or PM 9218 A Power Supply Adapter
Power Consumption: /02 versions 45 mW typical; /12 versions 180 mW typical (light on)
Safety: Class II acc. to IEC 348/VDE 0411/UL 1244
Warranty Period: 1 year
Size: 170 mm L x 55 mm W x 188 mm H (6.7 in L x 2.2 in W x 7.4 in H)
Weight: 0.7 kg (1.5 lb)
Included with instruments: PM 9266 safety leads and probes, operating manual, spare fuses

PM 2518, PM 2618, PM 2718 (Series 18)

Ordering Information

Models

January 1989 prices

PM 2518/023 Standard version	$275
PM 2518/123 Standard version with backlit display	360
PM 2618/023 Extended version	329
PM 2618/123 Extended version with backlit display	409
PM 2618/323 mAs version with backlit display	750
PM 2718/023 High accuracy version	379
PM 2718/123 High accuracy version with backlit display	459

Accessories (Also see page 127)

PM 9101/01 AC/DC Current Clamp	$495
PM 9210 50Ω HF Probe	259
PM 9212 Accessory Kit for PM 9210	220
PM 9213 Low cost HF (100 MHz) Probe	69
PM 9215/50 10MHz Logic View Probe	75
PM 9218A/013 Power Supply	40
PM 9244 30A Shunt	69
PM 9245 100A AC Current Probe	65
PM 9246/03 30 kV Probe	149
PM 9249/01 Pt 100 Temperature Probe	150
PM 9266 /02 Pair of Safety Test Leads	39
PM 9267/01 Data Hold Probe	150
PM 9278/02 Carrying Case	75

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Multimeter Accessories

Today's multimeters can become even more powerful tools through the use of accessories. High voltages and currents can be scaled down to levels that are safe to measure with a digital multimeter (DMM).

Temperature modules and thermocouple probes can convert a DMM into a thermometer. And high frequency probes allow a DMM to be used in situations that might otherwise require an oscilloscope.

This section includes a wide assortment of carrying cases, test leads and special accessories, too. In total, Fluke and Philips offer more accessories for more digital multimeters than anyone in the world.

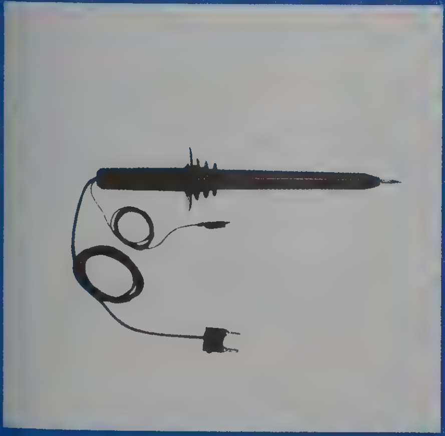
Our accessories are unsurpassed in quality of design and workmanship. And, they are compatible with other manufacturers' DMMS.

Page 137 80i-kw

Page 131 C100

Page 132 80T-150U

Page 130 TL20


Page 135 80k-40

Page 137 80i-600

Fluke-Produced Accessories
Selection Guide 128
Test Leads & Carrying Cases 130
Frequency, Temperature, High Voltage
Probes 132
Current Clamps 136
Philips-Produced Accessories
Selection Guide 129
Philips Accessories 138

Fluke-Produced Accessories

Fluke-Produced Accessory Selection Guide*

ACCESSORIES		DIGITAL VOLTMETERS and MULTIMETERS																								
		8025B	21	23	25, 27	37	73	75	77	83	85	87	8010A	8012A	8020B	8021B	8024B	8026B	8050A	8060A	8062A	8500 Series	8840 Series	8920A	8921A	8922A
TL20	Test Lead Set	(4)	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	•	•	—	•	—	—	—
TL70	Test Lead Set	•	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	—	—	(4)	(4)	(4)	(4)	(4)	(4)	(4)	—	(4)	—	—	—
Y8131	Test Lead Set	—	—	—	—	—	—	—	—	—	—	—	(4)	(4)	—	—	—	—	—	—	—	•	—	(1)	•	(1)
Y8132	Test Lesd Set	•	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	•	•	—	•	—	—	—
Y8133	Test Lead Set	—	—	—	—	—	—	—	—	—	—	—	•	•	—	—	—	—	—	—	—	•	—	(1)	•	(1)
Y8134	Test Lead Set	•	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	•	•	•	—	•	—	—	—
Y8140	Test Lead set	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
C20	Hard Case	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C25	Soft Case	—	(6)	(6)	•	—	—	(6)	(6)	(6)	(6)	(6)	—	—	(9)	(9)	(9)	(9)	—	(9)	(9)	—	—	—	—	—
C50	Soft Case	—	•	—	—	—	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C70	Holster	—	•	(4)	—	—	•	•	(4)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C81G	Holster Grey	—	—	—	—	—	—	—	—	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C81Y	Holster Yellow	—	—	—	—	—	—	—	—	(4)	(4)	(4)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C86	Hard Case	—	—	—	—	—	—	—	—	—	—	—	•	•	—	—	—	—	•	—	—	—	—	—	—	—
C90	Soft Case	—	(6)	(6)	—	—	—	(6)	(6)	—	—	—	—	—	•	•	•	•	—	•	•	—	—	—	—	—
C100	Hard Case	(4)	•	•	•	—	•	•	•	•	•	•	—	—	•	•	•	•	—	•	•	—	—	—	—	—
Y8205	Soft Case	—	—	—	—	—	—	—	—	—	—	—	•	•	—	—	—	—	•	—	—	—	—	—	—	—
A81	Battery Eliminator	—	—	—	—	•	—	—	—	—	—	—	—	—	•	•	•	•	—	•	•	—	—	—	—	—
80T-H	Touch-Hold Probe	(5)	—	(5)	(5)	(5)	—	—	(5)	(5)	(5)	(5)	•	•	—	—	—	—	•	—	—	—	—	—	—	—
83RF	R.F. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
85RF	R.F. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
80TK	Temp. Module	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(5)	•	•	•	•	•	•	(1)	•	(1)
80T-150U	Temp. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
80T-SP	Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—
Y8102	Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—
Y8103	Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—
Y8104	Temp. Termination	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—
80K-6	H.V. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
80K-40	H.V. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
80J-10	Current Shunt	(5)	•	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
Y8100	Current Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(8)	(1)	•	(1)
Y8101	Current Probe	•	•	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(3)	(8)	(3)	(3)	(3)
80i-400	Current Probe	•	(7)	•	•	•	—	•	•	•	•	•	—	—	•	•	•	•	•	•	•	—	(8)	—	—	—
80i-410	Current Probe	•	(10)	(10)	•	•	(10)	(10)	(10)	•	•	•	—	—	•	•	•	•	•	•	•	—	(8)	—	—	—
80i-600	Current Probe	•	(7)	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(3)	(8)	(3)	(3)	(3)
80i-1010	Current Probe	•	(10)	(10)	•	•	•	(10)	(10)	•	•	•	—	—	•	•	•	•	•	•	•	—	(8)	—	—	—
80i-kW	Current/Power Probe	•	(10)	(10)	•	•	•	(10)	(10)	•	•	•	—	—	•	•	•	•	•	•	•	—	(8)	—	—	—
LCA-10	Line Current Test Adapter	•	—	•	•	•	•	•	•	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y9108	BNC Adapter	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	•	—
Y9109	BNC Adapter	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	•

• Means Compatible and recommended

—Not compatible, not recommended, or not applicable

(1) Y9109 Adapter required

(2) On some ranges inputs must be shunted to equal 10 MΩ

(3) Current-measuring option required or A90

(4) Included with DMM

(5) Feature of DMM alone

(6) Accomodates DMM with Holster

(7) Compatible, 320A maximum

(8) Requires ac option for ac current

(9) Loose fit

(10) 1 amp resolution for ac current

**For additional accessories see page 485 (rackmounts, cables, etc...)*

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

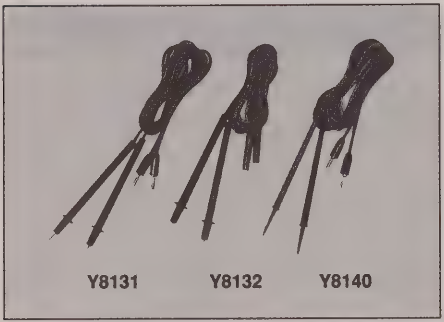
Philips-Produced Accessories

Philips-Produced Accessory Selection Guide

Item	Model Number	Description	PM 2504	PM 2505	PM 2518	PM 2618	PM 2718	PM 2518 /02	PM 2618 /02	PM 2718 /02	PM 2519 *	PM 2521 *	PM 2525	PM 2528	PM 2534	PM 2535	PM 2544	PM 2554
Measurement Cables	PM 9071	Banana-Banana 135 Ohm	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	
	PM 9072	Banana-BNC 135 Ohm	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	PM 9074	BNC-BNC 50 Ohm																Δ
Adapters	PM 9051	Adapter BNC-Banana				Δ	Δ											Δ
	PM 9053	Adapter Banana-BNC	Δ		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	
	PM 9061	Adapter BNC-BNC																Δ
	PM 9067	T-Piece BNC																Δ
Test Leads	PM 9260/00	Pair of Test Leads	•	•									Δ					
	PM 9266/02	Pair of Safety Test Leads			•	•	•	•	•	•	•	•	•	•	•	•	•	
	PM 9264/01	4-Wire Test Leads											Δ	Δ	Δ	Δ		
	PM 9265/01	Measuring Cable												Δ	Δ	Δ		
	PM 8924/00	1:1 Passive Probe																Δ
	PM 8926	10:1 Passive Probe																Δ
	PM 9263/01	Hold Probe										Δ		Δ				
	PM 9267/01	Hold Probe			Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ		Δ	Δ		
	PM 9215/50	Logic View Probe				Δ	Δ		Δ	Δ								
HF Accessories	PM 9258/01	HF Option												Δ				
	PM 9210	HF Probe	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	
	PM 9211/00	HF Probe Set (Linear)												Δ				
	PM 9212	Accessory Set for PM 9210	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	
	PM 9213	Low cost HF Probe	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	
HT Probe	PM 9246/03	30 kV Probe	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	
Peak Voltage	PM 9259/01	Peak Voltage Option												Δ				
Temp. Probes	PM 9249/01	Temperature Probe			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		
Current Accessories	PM 9244	30A Shunt	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	PM 9245	100A Transformer	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	
Power Line Adaptors	PM 9218A/013	Power Line	Δ		Δ	Δ	Δ	Δ	Δ	Δ								
	PM 9111/01	Power Line (220V)		Δ														
Carrying Cases	PM 9278/02	Ever-Ready Case		Δ	Δ	Δ	Δ	Δ	Δ	Δ								
	PM 9279/01	Carrying Case									Δ	Δ					Δ	
Rack Mount	PM 9280/02	(2E High) 19" Rack Mount Kit													Δ	Δ		
	PM 9669/03	Rack Mount Unit												Δ				
	PM 2193/01	3E Rackmount Kit											Δ					
	PM 9606/00	Rackmount Kit													Δ	Δ		
Interfaces	PM 9292/02	BCD Output												Δ				
	PM 9191/02	Bus-Line Interface									Δ							
	PM 9291/02	Bus-Line Interface												Δ				
	PM 9254/02	Analog Output												Δ				
Linearizers	PM 9877 J/2	Thermocouple Module J-type											Δ					
	PM 9877 K/2	Thermocouple Module K-type											Δ					

•Included in delivery *ΔOptional* **No longer available*

Fluke-Produced Accessories



Y8131 Test Lead Set $11

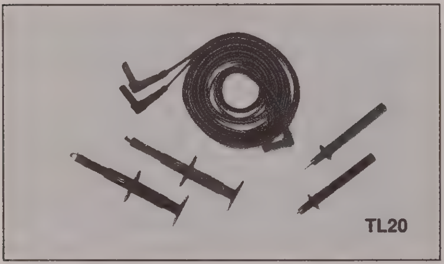
Four-foot test leads feature exposed banana plugs on one end and detachable probes with solid pin tips and finger guards on other end. Compatible with Y9134 Alligator Clips. See Selection Guide for compatible DMMs.

Y8132 Test Lead Set $11

Same as Y8131 except safety designed banana plugs are shrouded by an insulating shield. See Selection Guide for compatible DMMs.

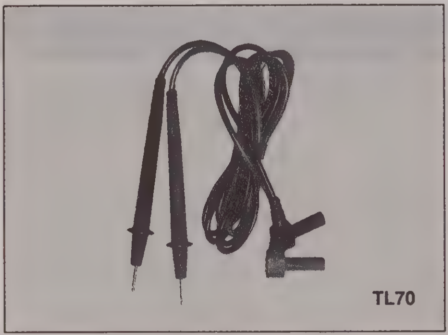
Y8140 Test Lead Set $20

Slim, retractable, insulated, needle-point tips adjust to desired length. Tough, thin insulation extends all the way to the points to prevent shorting adjacent components or conductors. Needle points easily pierce varnish and thin insulation to give good electrical contact. Four-feet long. See Selection Guide for compatible DMMs.



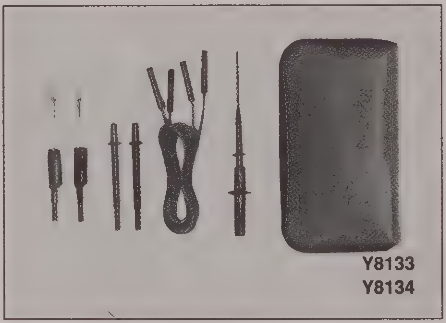
TL20 Test Lead Set $35

Sixty-three inch silicon insulated test leads that remain flexible from -100°C to 300°C (-148°F to 572 °F). Leads have shrouded right-angle connections. Interchangeable stainless steel test probes and sagety alligator clips. See Selection Guide for compatible DMMs.



TL70 Test Lead Set $8

Safety-designed right angle plugs shrouded by insulating shield. Strain relief where wire joins probes 53-inches long. Compatible with AC90 Alligator Clips. See Selection Guide for compatible DMMs.



Y8133 Test Lead Kit $22

Y8133 includes a black and a red insulated wire lead each having an exposed banana plug on one end and a safety-designed, shrouded banana plug on the other. Leads have strain relief for long life. Also included are two insulated alligator clips, two spade lug tips, a spring-loaded hook tip, and two probes with solid metal pin tips, finger guards, and pouch. Any of the clips, tips, and probes may be plugged onto the shrouded banana plug on either wire lead. See Selection Guide for compatible DMMs.

Y8134 Test Lead Kit (Shown) $22

Same as Y8133 Test Lead Kit except banana plugs are shrouded by an insulating shield on both ends of each lead. See Selection Guide for compatible DMMs.

Y9134 Alligator Clips $17

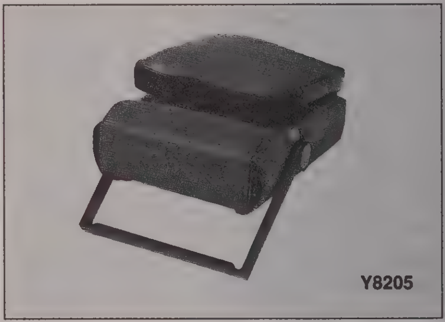
Package of ten insulated alligator clips with banana jack. Five red and five black. For Y8131 through Y8134.

Y9104 Alligator Clips $12

Package of six black slip-on insulated alligator clips for ground connections. Compatible with pin-tip size probes except TL70.

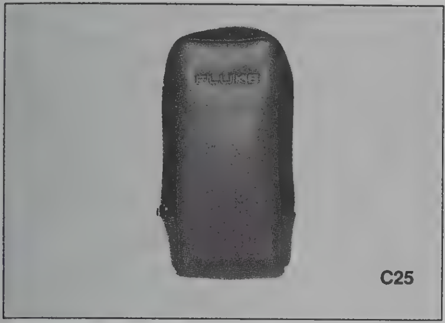
AC70 Alligator Clips $5

Package of four slip-on, insulated alligator clips. Two red and two black. Compatible with TL70 or other pin-tip size probes.



Y8205 Soft Carrying Case $35

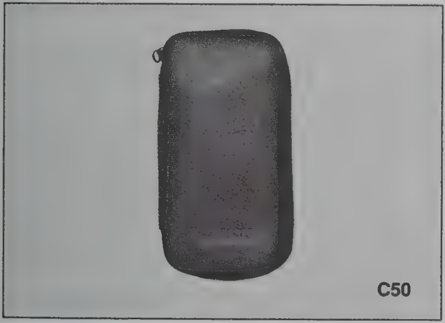
A soft vinyl plastic case designed for the storage and transport of either an 8000A, 8010A, 8012A, 8050A, 2165A, 2166A, 2168A, 2175A, 2176A, or 8600A DMM. A separate storage compartment is provided for test leads and other compact accessories.



C25

C25 Soft Carrying Case $16

Thickly padded vinyl with tough exterior and interior and heavy-duty water resistant zipper. Holds DMM and test leads. Includes combination belt loop/carrying strap and two storage pockets. For Fluke 25/27 and 8025A. Also accomodates small accessories and Fluke 21, 23, 73, 75, 77 Meters in C70 holster.



C50

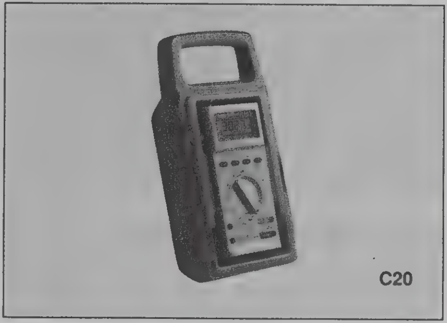
C50 Soft Carrying Case $13

A soft, zippered vinyl case for Fluke 21, 23, 73, 75, 77 Multimeters when not in C70 Holster. Includes pocket for test leads. Use C25 with holster.

C90

C90 Soft Carrying Case $13

Constructed of double-wall, fabric-backed vinyl with padded interior and zippered closure for complete protection. Inside pocket holds test leads and operator's instruction card. Carrying strap doubles as belt loop holder. Accommodates 20 and 70 Series DMMs in C70 Holster. For all Fluke handhelds except 25 and 27 DMMs.



C20

C20 Hard Carrying Case $20

The C20 is a heavy duty hard case made of shock resistant polypropylene. A carrying handle, operator's guide decal, and storage compartment for test leads and other small items is included. The cover is secured by two latches that also latch the case top to the back of the case for convenient storage and to form a tilt-up stand. For Fluke 25/27 and included with Fluke 8025A.

C86

C86 Hard Carrying Case $20

The Model C86 Carrying Case is a molded polyethylene container designed for either an 8010A, 8012A, 8000A, 8050A, or 8600A DMM. This rugged case provides the DMM with maximum protection against rough handling and adverse weather conditions. A separate storage compartment is provided for test leads and other compact accessories.

C100

C100 Hard Carrying Case $30

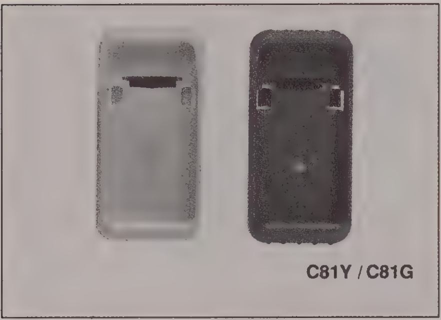
A tough, polypropylene case that provides protection against rough handling and bad weather. Will also hold 80i-600, 80i-400 or Y8101 Current Probes and smaller accessories. Resembles C86. See Selection Guide for compatible Handheld Multimeters.

C70

C70 Multipurpose Holster $10

The C70 is for Fluke 21, 73 and 75 Multimeters and is included with the Fluke 23 and 77 models. It is made of a tough semiflexible plastic that snaps over the instrument to absorb shocks and protect the meter from rough handling. The holster also doubles as a tilt stand and includes a belt clip. Holster stores test leads and probes. Probes may be snapped into holster so only one hand is needed to hold both the meter and probe tip in contact with test point.

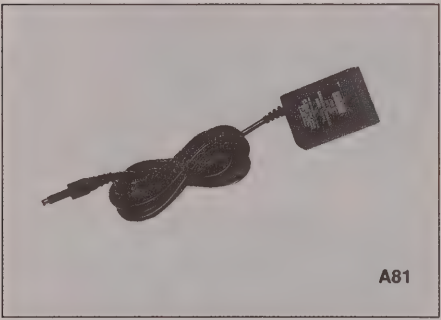
Fluke-Produced Accessories



C81Y / C81G

C81G/C81Y $14

The C81G and C81Y fit Fluke 80 series multimeters. Yellow version (C81Y) is included with multimeter. Gray version (C81G) is optional. Made from durable semiflexible plastic, the C81 holster snaps in place around the multimeter to protect it form rough handling. Flexible rear stand/bail has multiple uses including tilt stand, belt loop, pipe hook etc... Holster stores test leads and probes. Probes may be snapped into holster so only one hand is needed to hold both the meter and probe tip in contact with test point.

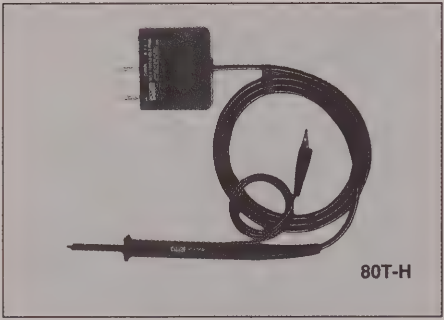


A81

A81 Battery Eliminator $20

The A81 provides line operation for DMMs without discharging their disposable batteries. Available in three line voltage versions. Specify version desired. See Selection Guide for compatible DMMs.

A81-115 115V input (U.S. plug)
A81-230 230V input (European plug)
A81-100 100V input (U.S. plug)

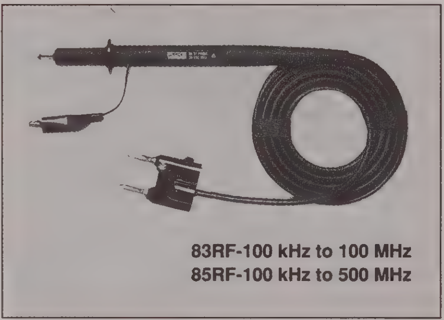


80T-H

80T-H Touch-Hold Probe $59

The 80T-H is a direct signal-through test probe with a touch and hold feature. Touch-and-hold allows voltage or resistance readings to be held on a digital multimeter display following contact of the probe tip with the test point. Operator can devote full attention to manipulating the probe until the measurement is complete, then remove the probe and observe the reading on the DMM. Activation of a pushbutton on the probe causes the DMM to hold the last number displayed until the pushbutton is released. Works with 8010A, 8012A, 8050A only.

Voltage Rating:
Tip to Common: 1000V dc or peak ac maximum
Common to Ground: 60V dc or 42V peak ac maximum
Input Capacitance: 150 pF maximum
Lead Resistance: 0.58Ω maximum



83RF-100 kHz to 100 MHz
85RF-100 kHz to 500 MHz

83RF High Frequency Probe $55

The 83RF converts a 10 megohm input resistance dc voltmeter into a high frequency, 100 kHz to 100 MHz, ac voltmeter. Conversion from ac to dc is on a one-to-one basis over a range of 0.25 to 30V rms. The probe's dc output is calibrated to be equivalent to the rms value of a sinewave input.

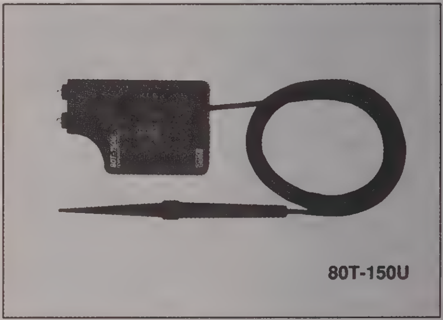
AC-to-DC Ratio: 1:1
Ratio Accuracy: ±1 dB above 1V; ±1.5 dB below 1V (at 1 MHz with 10 MΩ load)
Frequency Response: ±1 dB 100 kHz to 100 MHz (relative to 1 MHz)
Extended Frequency Response: Relative readings from 20 kHz to 250 MHz
Response: Responds to peak value of input; calibrated to read rms value of a sinewave
Voltage Range: 0.25 to 30V rms
Maximum Input Voltage: 30V rms, 200V dc
Input Capacitance: Approximately 3 pF

85RF High Frequency Probe $85

The 85RF is designed to convert a 10 megohm input resistance dc voltmeter into a high frequency, 100 kHz to 500 MHz, ac voltmeter. Ac to dc conversion ratio is one-to-one over a range of 0.25 to 30V rms. The probes dc output is calibrated to the rms value of a sinewave input.

AC-to-DC Ratio: 1:1
Ratio Accuracy: ±0.5 dB above 0.5V (at 1 MHz with 10 MΩ load) ±1 dB below 0.5V
Frequency Response: ±0.5 dB 100 kHz to 100 MHz; ±1.0 dB 100 MHz to 200 MHz;* ±3.0 dB 200 MHz to 500 MHz* (relative to 1 MHz)
Extended Frequency Response: Relative readings from 20 kHz to 700 MHz
Response: Responds to peak value of input; calibrated to read rms value of a sinewave
Voltage Range: 0.25 to 30V rms
Maximum Input Voltage: 30V rms, 200V dc
Input Capacitance: Approximately 3 pF

**Referred to high and low inputs at probe tip*

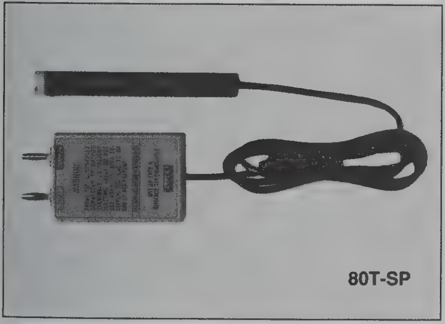


80T-150U

80T-150U Temperature Probe $120

The 80T-150 is a universal temperature probe designed to provide virtually all DMMs with temperature measuring capability. Intended for air, surface, and non-corrosive liquids, the probe provides direct temperature conversion of 1 mV dc per degree. A three-position switch on the unit acts as a power switch and is used for selecting Celsius or Fahrenheit scaling for the output. In addition, the OFF position of the power switch allows the battery condition to be determined via the external DMM. Operating power for the 80T-150U is derived from a standard 9 volt battery. Typically, the battery provides more than 1600 hours of continuous operation before replacement is necessary. An outstanding feature of particular importance to electronically-oriented users is the probe's ability to stand off voltages to 350V dc or peak ac. This allows voltages to be present on devices whose temperature is being measured. Resolution is 0.1° on the 200 mV range of a 3-digit DMM. Most accurate DMM temperature probe System.

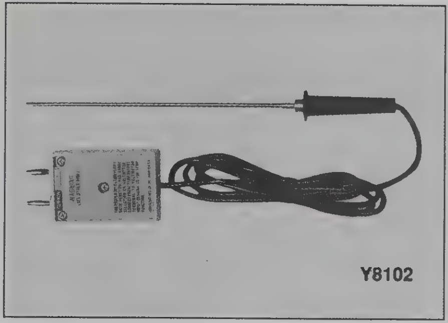
Temperature Range: -50°C to +150°C or -58°F to +302°F, cable 70°C maximum
Celsius-Fahrenheit Selection: Switch selected
Sensitivity: 1 mV per °C or °F
Resolution: 0.1°C or 0.1°F recommended maximum
Ambient Temperature Range for Unit: 0°C to +50°C
Relative Humidity: 90%, non-condensing from 0°C to 35°C
Accuracy: (Including nominal 0.25% voltmeter error, in +15°C to +35°C ambient)
±1°C (1.8°F) 0°C to 100°C, decreasing linearly to ±3°C (5.4°F) at -50°C and +150°C



80T-SP Type K Surface Thermocouple $95

For use with 8024A and 8024B for measuring the temperature of flat or slightly convex surfaces.

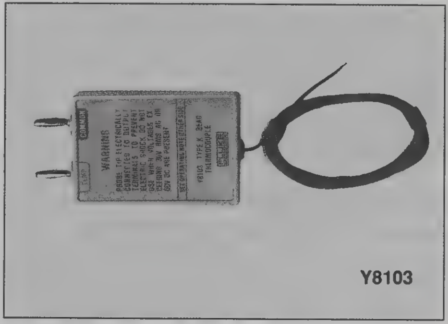
Time Constant: 4 seconds typical on metal surface; 15 seconds max for a 260°C change
Range: 0°C to 260°C, handle and cable 105°C maximum
Accuracy: ±2.2°C from 0°C to 260°C (with respect to NBS thermocouple tables). Also depends on good contact between the tip and the surface to be measured.
Probe Diameter: 12.5 mm (.5 in)
Probe Length: 9.4 cm (3.75 in)
Conductor Length: 1.12m (48 in)



Y8102 Type K Thermocouple Probe $62

Designed for use with Fluke 8024A and 8024B Digital Voltmeter. Sheath material is Inconel, especially good for liquid immersion measurements.

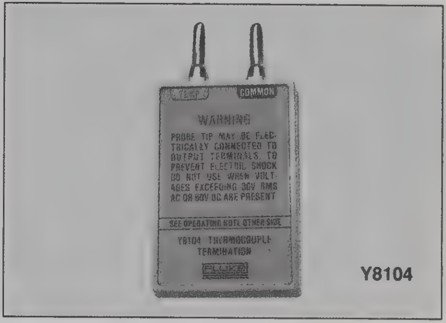
Time Constant: 10 seconds, for air at room temperature and one atmosphere of pressure moving 65 feet per second
Temperature Range: 0°C to 926°C (32°F to 1700°F)
Accuracy: ±2.2°C from 0°C to 276.7°C and ±0.75% of reading from 276.7°C to 926°C
Probe Diameter: 3.18 mm (0.125 inch)
Probe Length: 15.2 cm (6 inches)
Conductor Length: 1.12 meters (48 inches)



Y8103 Type K Bead Thermocouple $26

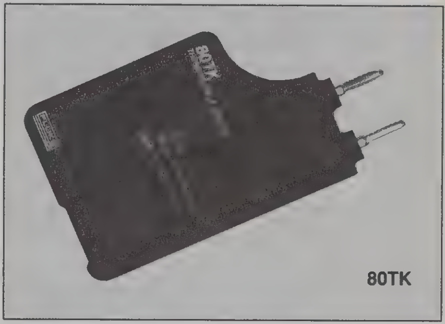
For use with 8024A and 8024B in any application except liquid immersion or penetration. Exposed tip provides fast response. Teflon insulation. Four feet.

Time Constant: 2 seconds, for air at room temperature and one atmosphere of pressure moving 65 feet per second
Temperature Range: 0°C to +260°C (32°F to +500°F)
Accuracy: ±2.2°C from 0°C to +260°C
Useable Range: To -40°C (-40°F)



Y8104 Thermocouple Termination $11

The Model Y8104 Thermocouple Termination provides isothermal termination for any Type K thermocouple wire connected to 8024A and 8024B. The isothermal nature of the Y8104 ensures that there is no temperature difference between the junctions created by the instrument and the connection of the thermocouple to the terminals. Maximum wire size is #14 AWG.



80TK Thermocouple Module $65

The Fluke 80TK Thermocouple Module is a low cost temperature measurement accessory designed to work with any digital multimeter. It converts the microvolt output from a "K" type thermocouple into a 1 millivolt per degree signal.

The on-off switch allows selection of degrees "C" or "F" output scaling. Input is via a "mini" thermocouple connector, with provision inside for hardwiring. **A bead thermocouple, with miniconnector attached, is included with the 80TK.** Immersion probes and surface probes are also available, as are additional bead probes.

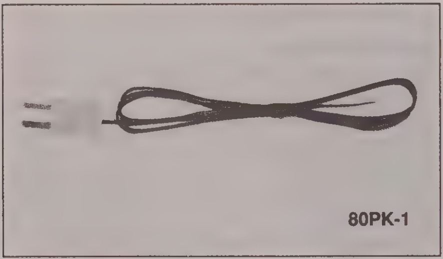
The output of the 80TK may be read on any DMM having 10 Mohm or greater input impedance and a 3-digit display. It is powered by a standard 9V battery, with a typical operating life

Fluke-Produced Accessories

of 1600 hours. Battery condition can be checked on the DMM with battery test instructions printed on the 80TK.

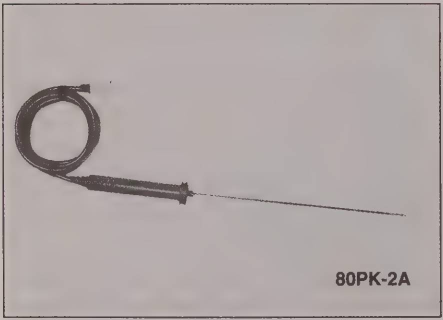
Measurement Range: -50°C to 1000°C (-58°F to 1832°F)
Ambient Operating Range: 0°C to 50°C, 32°F to 122°F
Accuracy:

-50°C to -20°C 2.5% ±2°C -58°F to -5.8°F 2.5±3.6°F	350°C to 500°C 1.75% ±2°C 665°F to 932°F 1.75% ±3.6°F
-20°C to 350°C 0.5% ±2°C -4°F to 662°F 0.5% ±3.6°F	500°C to 1000°C 2.0%±2°C 933°F to 1832°F 2.0%±3.6°F


80PK-1

80PK-1 K-Type Bead Probe $12

Accuracy: (with respect to NBS tables): +1.1°C (2.0°F) over the range of 0°C to 260°C (32°F to 500°F). Typically within 1.1°C of NBS tables over the range of -40°C to 0°C (-40°F to 32°F)
Restrictions: Must be used in Teflon-compatible environments and is not suitable for liquid immersion. The 260°C (500°F) continuous temperature rating is primarily determined by the Teflon insulation.

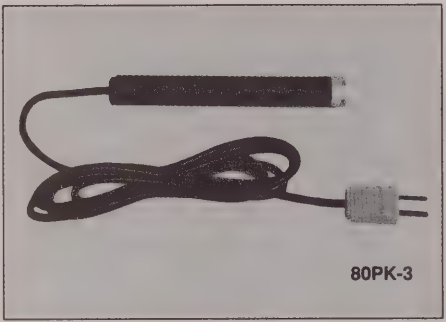

80PK-2A

80PK-2A K-Type Immersion Probe $36

Accuracy: (with respect to NBS tables)

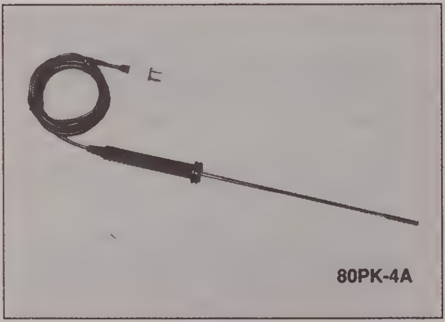
Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±4% of Rdg
-110°C to -40°C (-166°F to -40°F)	±4.4°C (4°F)
-40°C to 275°C (-40°F to 527°F)	±2.2°C (2°F)
275°C to 1090°C (559°F to 1922°F)	±.0.4% of Rdg

Restrictions: The sheath material of the 80PK-2A is Inconel. It should not be used in the presence of sulfur above 537°C (1000°F).


80PK-3

80PK-3 K-Type Surface Probe $69

Accuracy: (with respect to NBS tables): +1.1°C (2.0°F) over the range of -28°C to +260°C (-18.4°F to 500°F)
Restrictions: The 260°C continuous temperature rating is primarily determined by the Teflon support piece. The Teflon insulation should not be exposed to temperatures exceeding 260°C (500°F) nor to open flame, since this can cause release of toxic material.

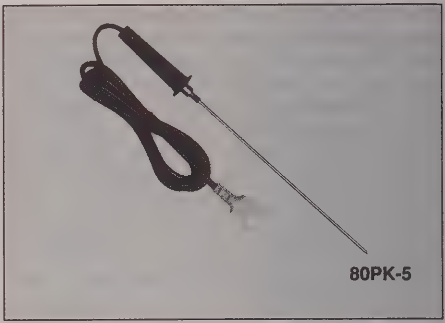

80PK-4A

80PK-4A K-Type Air Probe $49

Accuracy: (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±2% of Rdg
-110°C to -40°C (-166°F to -40°F)	±2.2°C (4°F)
-40°C to 275°C (-40°F to 527°F)	±1.1°C (2°F)
275°C to 816°C (559°F to 1598°F)	±0.4% of Rdg

Restrictions: The 304 stainless steel baffle should not be exposed to halides or sulfides.

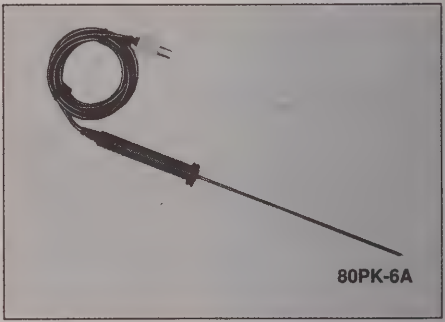

80PK-5

80PK-5 K-Type Piercing Probe $36

Accuracy: (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±2% of Rdg
-110°C to -40°C (-166°F to -40°F)	±2.2°C (4°F)
-40°C to 275°C (-40°F to 527°F)	±1.1°C (2°F)
275°C to 816°C (559°F to 1500°F)	±0.4% of Rdg

Restrictions: The sheath material of the 80PK-5 is 316 stainless steel. It should not be exposed to halides or sulfides.


80PK-6A

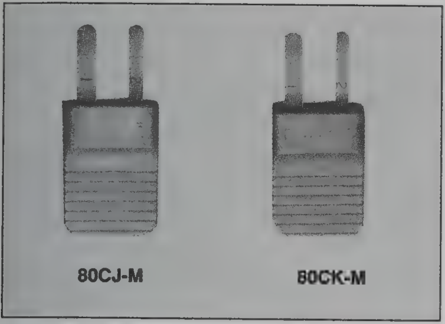
80PK-6A K-Type Exposed Junction Probe $43

Accuracy: (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±2% of Rdg
-110°C to -40°C (-166°F to -40°F)	±2.2°C (4°F)
-40°C to 275°C (-40°F to 527°F)	±1.1°C (2°F)
275°C to 870°C (559°F to 1598°F)	±0.4% of Rdg

Restrictions: The sheath material is 304 stainless steel. It should not be exposed to halides or sulfides. In addition, the probe should not be used in reducing atmospheres or a vacuum.*

**Because of the open access to the inside of the sheath via the exposed bead, the probe must not be immersed in liquid or saturated vapor. Immersion of the probe in liquid or saturated vapor could result in "wicking" of the substance, and possible corrosion.*



80CJ-M Male Mini Connector $7

Package of two male black mini-connectors (20 guage max.) for use with Fluke 50 Series. Isothermal screw terminals for attachment of J-type thermocouple wire.

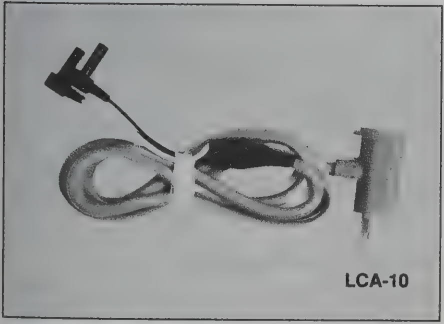
80CK-M Male Mini-Connector $7

Package of two male mini-connectors for use with Fluke 80TK or Fluke 50 Series. Isothermal screw terminals for attachment of K-type thermocouple wire.

Fuses

Fuse-2A 2A/250V fuse, 5 ea.
Fuse-3A 3A/600V fuse, 1 ea.
Fuse-20A 20A/600V fuse, 1 ea.
Fuse-630 mA 630 mA/250V sand-filled, 5 ea

These fuses are provided to ensure proper protection for Fluke DMMs. These are the only fuses that should be used.

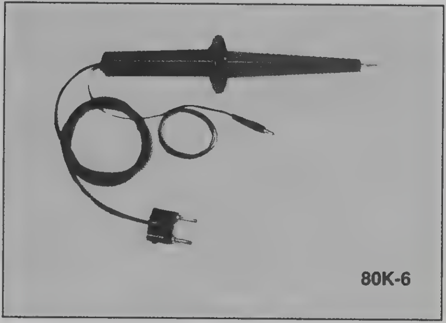


LCA-10 Line Current Test Adapter $13

The LCA-10 Line Current Test Adapter is a low-cost multimeter accessory that allows you to quickly and accurately measure the amount of current used by 120V ac line-powered devices.

The LCA-10 looks similar to an extension cord except that one end has Fluke-compatible safety-designed shrouded banana plugs. These plugs connect the LCA-10 to the high current input (typically 10A) of your multimeter. Inserting the banana plugs into the multimeter places the 120V ac live wire in series with the multimeter current shunt. The other end of the cord plugs into a 120V ac receptacle. The device being measured plugs into the LCA-10 receptacle.

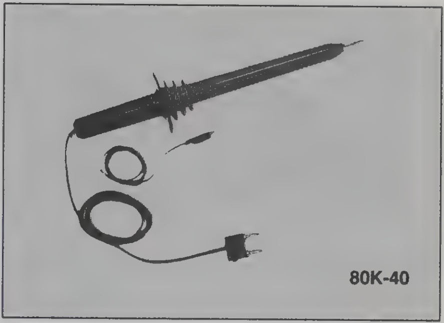
Plug and Receptacle: U.S. NEMA 5-15 compatible (3 wire, straight blade, 15A, 125V ac)
Output Connections: Safety-designed shrouded banana plugs
Maximum Current: 10A ac continuous, 20A ac for 30 seconds
Wire: 5 feet of 16 gauge SJT



80K-6 High Voltage Probe $49

The 80K-6 extends the voltage measuring capability of an ac/dc voltmeter up to 6000 volts. A 1000:1 voltage divider provides a high input impedance. High accuracy is provided when the divider is used with a voltmeter having a 10 MΩ input impedance. A molded plastic body houses the divider and protects user from voltage being measured.

Voltage Range: 0 to 6 kV, dc or peak ac
Input Impedance: 75 MΩ, nominal
Division Ratio: 1000:1
Accuracy:
DC to 500 Hz: ±1%
500 Hz to 1 kHz: ±2%
Above 1 kHz: Output reading falls; typically, -30% at 10 kHz
DVM Compatibility: The 80K-6 achieves rated accuracy when used with an ac/dc voltmeter having 0.25% accuracy, or better, and an input impedance of 10 MΩ ±10%.
Caution: These probes are not intended for electric utility applications in which high voltage is also accompanied by high energy. They are also not intended for use on 3 phase line-to-line measurements. Rather, they are intended for use in lower energy applications such as television and CRT troubleshooting.

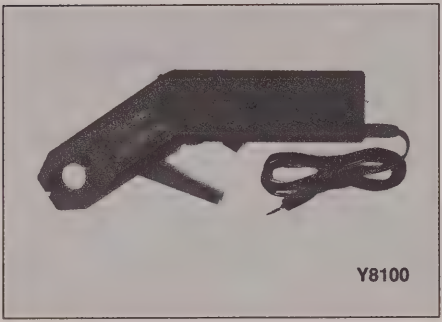


80K-40 High Voltage Probe $85

The Model 80K-40 is a high voltage accessory probe designed to extend the voltage measuring capability of an ac/dc voltmeter up to 40,000 volts. In essence the probe is a precision 1000:1 voltage divider formed by two matched metal-film resistors. The unusually high input impedance offered by these resistors minimizes circuit loading and optimizes measurement accuracy. A special plastic body houses the divider and provides the user with isolation and protection from the voltage being measured.

Voltage Range: 1 kV to 40 kV dc or peak ac, 28 kV rms ac
Input Resistance: 1000 MΩ
Division Ratio: 1000:1
DC Accuracy: ±2% from 20 kV to 30 kV (calibrated 1% at 25 kV); changes linearly from 2% at 30 kV to 4% at 40 kV and from 2% at 20 kV to 4% at 1 kV
AC Accuracy: ±5% at 60 Hz
DVM Compatibility: The 80K-40 achieves rated accuracy when used with an ac/dc voltmeter having 0.25% accuracy, or better, and an input impedance of 10 MΩ ±10%.
Caution: These probes are not intended for electrical utility applications in which high voltage is also accompanied by high energy. They are also not intended for use on 3 phase line-to-line measurements. Rather, they are intended for use in lower energy applications such as television and CRT troubleshooting.

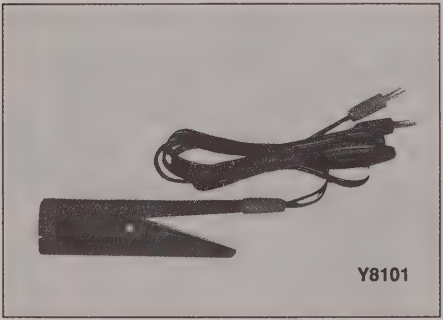
Fluke-Produced Accessories


Y8100

Y8100 Clamp-on DC or AC Current Probe $259

The Model Y8100 is a clamp-on, Hall-effect probe that can be used with a voltmeter, multimeter, or oscilloscope to read dc, ac, or composite (ac/dc) current measurements. The pistol shape allows safe, easy, one-hand operation when making current measurements. Two ranges, 20A and 200A, produce a 2V output at full range current. The probe battery-low indicator light lets the operator know when the battery voltage is too low for proper operation.

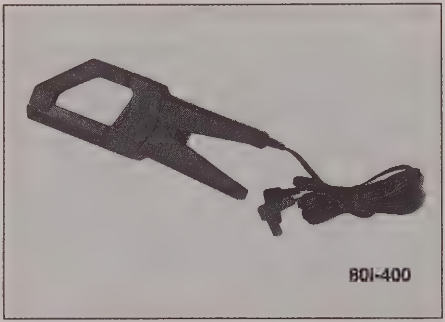
Ranges: 20A ac or dc and 200A ac or dc
Accuracy:
DC to 200 Hz: ±2% of range
200 Hz to 1 KHz: 1-100A add ±3% of reading;
200 Hz to 1 KHz: 2-100A add ±6% of reading
Working Voltage: Core to output; 600V dc or 480V ac maximum. Output to ground; 42V dc or 30V ac maximum
Maximum Conductor Size: 1.9 cm (.75 in)


Y8101

Y8101 Clamp-on AC Current Probe $69

The Y8101 is a small clamp-on current transformer designed to extend the current measuring capability of a DMM or ac current meter up to 150 amperes. The coil on the clamp-on core serves as the secondary of a 1000:1 ratio transformer. The current-carrying conductor being measured serves as the primary.

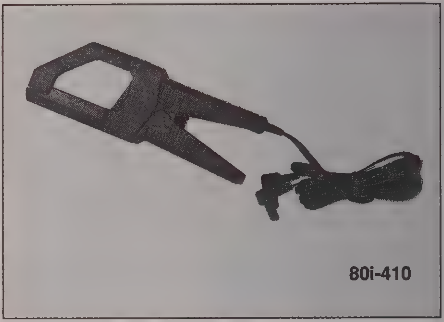
Current Range: 1A to 150A
Accuracy:
48 Hz to 440 Hz ±(2.5% of reading +0.15A);
440 Hz to 1200 Hz ±(3% of reading +0.15A)
Division Ratio: 1000:1
Working Voltage: 300V ac rms maximum
Maximum Conductor Size: 1.11 cm (0.43 in)
Usable Current Range: 0.1A to 200A, 5 seconds maximum above 150A


80i-400

80i-400 Clamp-on AC Current Probe $69

The Model 80i-400 is a clamp-on current probe designed to extend the current capability of an ac current meter to 400 amperes. A clamp-on, 1000-turn coil designed into the probe allows measurements to be made without breaking the circuit under test. The current carrying conductor being measured serves as the primary. The unique shape of the 80i-400 jaw will accommodate a single 750 MCM THHN (30mm diameter) conductor or two 500 MCM THHN (25mm diameter each) conductors run in parallel.

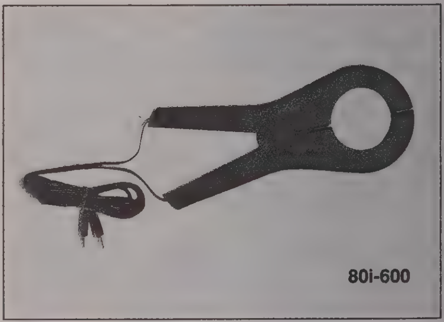
Current Range: 1A to 400A
Accuracy:
±(3% of reading +0.4A) 48 Hz to 440 Hz
±(4% of reading +0.4A) 440 Hz to 1000 Hz
Division Ratio: 1000:1
Working Voltage: 660V ac rms maximum
Maximum Conductor Size: 1 each 30mm (1.18 in) or 2 each 25mm (0.98 in)
Usable Current Range: 0.1A to 600A, 5 seconds maximum above 400A


80i-410

80i-410 Clamp-on DC/AC Current Probe $129

The Model 80i-410 ac/dc current probe extends the ac or dc capacity to 400 amps. This Hall-effect probe is relatively insensitive to conductor position within the jaws for good repeatability. Physical dimensions are identical to 80i-400 and will accommodate similar conductors. Out put signal 1 mV per amp.

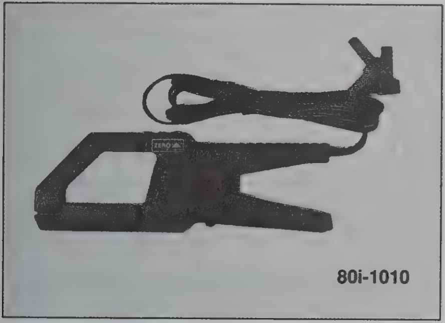
Specified Current Range: 5A to 400A ac or dc
Usable Current Range: 2A to 600A ac or dc
Accuracy: ±(5% + 2.5A) dc to 62 Hz
Working Voltage: 660V rms
Maximum Conductor Size: 1 ea 30mm (1.18 in) or 2 ea 25mm (0.98 in)


80i-600

80i-600 Clamp-on AC Current Probe $119

The Model 80i-600 is a clamp-on current transformer designed to extend the current measuring capability of a DMM or current meter to 600 amperes. A coil on the clamp-on transformer core allows measurements to be made without breaking the circuit under test. This coil serves as the secondary of a 1000:1 transformer. The current-carrying conductor being measured serves as the primary. Because of a high efficiency, evenly distributed winding, wire size and location of the wire within the transformer jaws will not affect the accuracy of current measurements.

Current Range: 1A to 600A
Accuracy:
±(2% of reading) 50 Hz to 1 kHz
±(3% of reading) typical 30 Hz to 50 Hz or 1 kHz to 10 kHz
Division Ratio: 1000:1
Working Voltage: 750V ac rms maximum
Maximum Conductor Size: 5 cm (2 in)
Usable Current Range: 0.1A to 2000A, 5 seconds maximum above 600A


80i-1010

80i-1010 Clamp-on DC/AC Current Probe $229

The 80i-600 is a battery powered clamp-on current probe that is used with a voltmeter to measure dc currents up to 1000 amps or ac currents up to 700 amps. The jaws will accommodate a single 750 MCM THHN or two 500 MCM THHN conductors. A convenient thumbwheel ZERO control improves accuracy of dc currents down to 1 amp. Typical frequency response is -3 dB at 6 kHz.

Specified Current Range: 1 to 1000A dc, 1 to 700A ac
Accuracy: (% of reading)

	dc	ac, 48 to 62 Hz	ac, 62 to 440 Hz
1 to 100A	2% + 1A	2% + 1A	3% + 1A
100 to 700A	3%	3%	5%
700 to 1000A	5%	Not specified	

Output Signal: 1 mV per amp dc or ac
Working Voltage: 660V rms maximum
Maximum Conductor Size: 1 each 30mm (1.18 in) or 2 each 25 mm (0.98 in)

80i-kW

80i-kW Current/Power Probe $395

The 80i-kW Current/Power Probe is a battery powered clamp-on probe. Used with a voltmeter to measure dc current from 1 to 1300 amps, ac current form 1 to 1000 amps and ac power from .5 to 330kW. Includes carrying case, test leads and manual with instructions for measuring power and finding power factor for single phase and three phase circuits. Compatible with multimeters that accept Fluke safety designed shrouded test leads.

Basic Accuracy:
± (2% + 2 amps) for current
± (3.5% + .5kW) for power
Jaw Size: 60 mm (2 3/8 in) x 73 mm (2 7/8)

80J-10 Current Shunt $35

An inexpensive, simple-to-use accessory that lets you measure ac or dc current using any sensitive voltmeter having banana jack inputs with a standard " spacing. Two 5-way binding posts become the current input terminals. The precision, 0.018 shunt resistor will pass 10 amperes continuously without overheating, or up to 20 am peres for one minute. Not compatible with Y8132, Y8134 or TL70 test lead sets.

Sensitivity: 10 mV per ampere
Shunt Resistance: 0.01Ω
Accuracy: ±0.25%, from dc to 10 kHz, typically rising to 1 dB at 100 kHz
Series Inductance: 8.3 nH
Overload: <20A, not fused

Rack Adapters

See page 487 for rack mounting accessories

Y9108 BNC-Banana Adapter $15

BNC-to-banana adapters permit interconnection between equipment having BNC plugs and equipment with double banana jacks. Caution: Do not use BNC Connectors for floating measurements. See page 486.

M00-100-714 Panel Protector $10

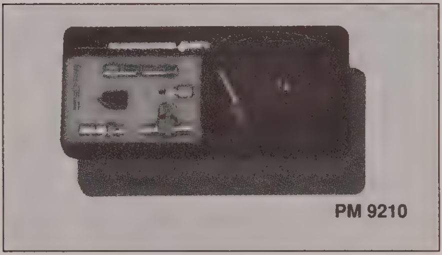
Dust cover for 8000A, 8600A, 1900A, 1910A, 1911A and 1912A. See page 486.

Philips-Produced Accessories

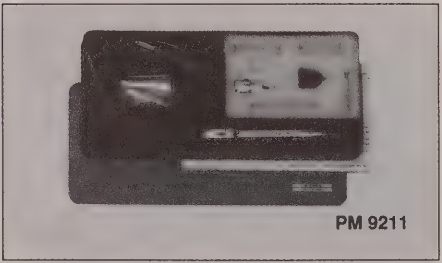
Specifications for PM 9210, PM 9211, PM 9212 and PM 9213

	PM 9211/00	PM 9211 w/Atten.	PM 9210	PM 9210 w/PM 9212	PM 9213
Frequency Range	10 kHz-1 GHz	10 kHz-1 GHz	100 kHz-1 GHz	100 kHz-1 GHz	10 kHz-100 MHz
Straight Line Within 5%	100 kHz-6 MHz	100 kHz-6 MHz	100 kHz-6 MHz	100 kHz-6 MHzx	30 kHz-30 MHz
Maximum Deviation	3 dB	3.5 dB	3 dB	3.5 dB	3 dB
Voltage Ranges (f.s.)	2 mV-2V	2V-200V	150 mV-15V*	15V-200V	10 mV-15V
Maximum Voltage AC	30V	200V	30V	200V	30V
Maximum Voltage DC	200V	500V	200V	500V	350V
Input Capacitance	2 pF	2 pF	2 pF	2 pF	40 pF
T-Piece	Included		Optional	Included	Not Available
Frequency Range	1.25 at 700 MHz	1.15 at 1 GHz		1.25 at 700 MHz 1.15 at 1 GHz (With Attenutor)	
Price	Not Available*	Not Available*	$259	$479	$69

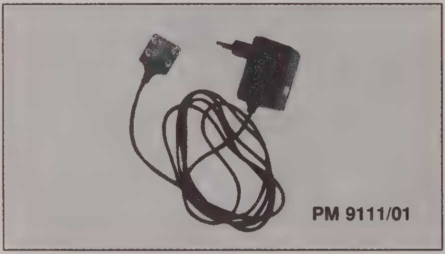
PM 9210 1 GHz, 50Ω Probe $259


PM 9210

PM 9211*

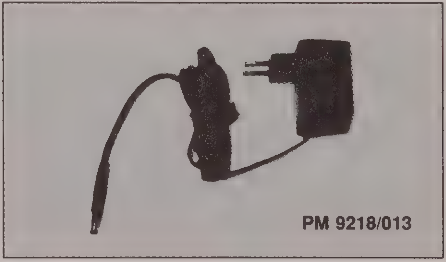

PM 9211

PM 9111/01 9V dc Power Supply*


PM 9111/01

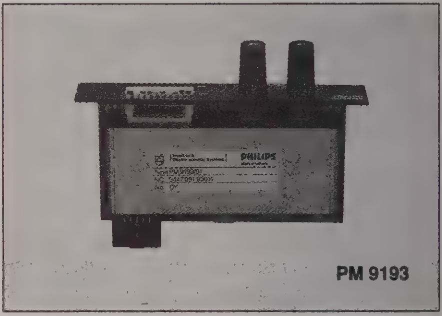
Input Voltage: 220V (±10%)
Line Frequency: 47...63 Hz
Power Consumption: 3 VA
Input Adapter: 2-Pole Universal European
Output Voltage (2x): 9V dc ±10%
Maximum Output Current: 10 mA

PM 9218A/013 Power Adapters $40


PM 9218/013

Provides power cord operation for PM 2518 and PM 2504.
Line Voltages: 110, 220 and 240V ±10%

PM 9193/01 Analog Output Opt $350

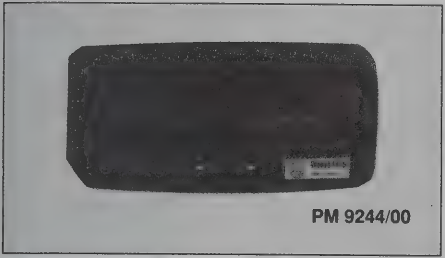

PM 9193

Can be used with PM 2534 and PM 2535
Power Supply: 5V (±5%)
Connector: 4 mm female banana type
Output Voltage: 0...1V
Output Protection: Short-circuit protected
Output Resistance: 200Ω
Accuracy: ±0.25% of reading ±0.25% of range
Dimensions: 118 W x 25 H x 60 mm D (4.6 x 1 x 2.4 in)

Not Available in North America

Philips-Produced Accessories

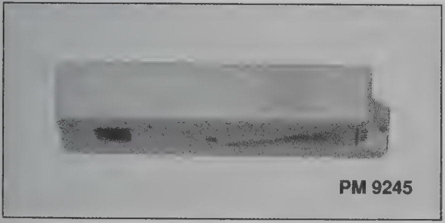
PM 9244 AC and DC Current Shunt Max 31.6A $69



PM 9244/00

Current Ranges: 10A and 31.6A
Frequency Range: DC...1 kHz
Output Voltage: 100 mV or 31.6 mV at full range
Accuracy: ±1% (100 mV range); ±2% (31.6 mV range)
Dimensions: 140 W x 55 H x 65 mm D (5.5 x 2.2 x 2.6 in)

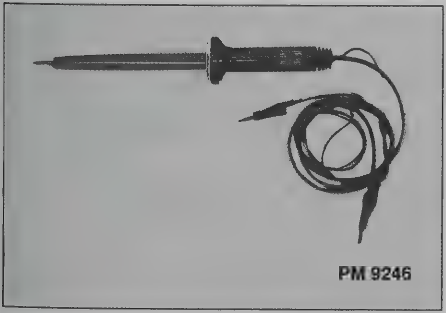
PM 9245 AC Current Transformer $65



PM 9245

Range: 10...150A
Transfer Factor: x1000
Accuracy: ±0.5% at 50 Hz; 2% for 40 Hz...10 kHz
Maximum Voltage to Ground: 400V (AC or DC)

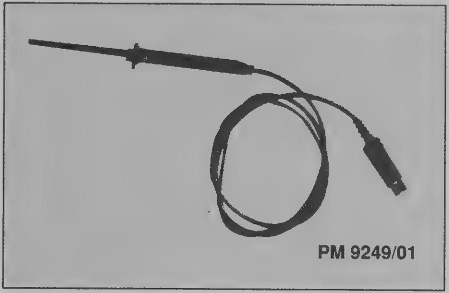
PM 9246/03 High Tension Probe $149



PM 9246

Maximum Input Voltage: 30 kV
Attenuation: x1000
Input Impedance: 600 MΩ ±1%
Accuracy: ±2%
Temperature Coefficient: ±200 ppm/°C
Voltage Coefficient: ±0.5 ppm/V
Input Impedance Meter: 10 MΩ, 100 MΩ or 1.2 MΩ
Output Connectors: 2 x 4 mm banana plug

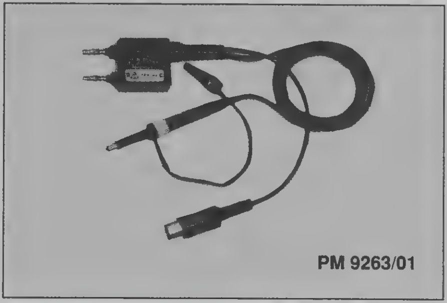
PM 9249/01 Temperature Probe $150



PM 9249/01

Application: Surface and liquids
Temperature Range: -60°C...200°C
Resolution: 0.1°C
Accuracy (excl. DMM): ±0.5%
Connector: 5-pole DIN (180°)

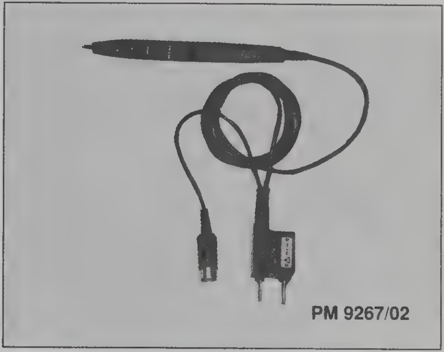
PM 9263/01 Data Hold Probe $85



PM 9263/01

Maximum Input Voltage: 30V rms
Input Resistance: 130Ω
Input Capacitance: 300 pF
Rated Range of Use: -10...+55°C
Storage and Transport: -25...+70°C
Humidity Operating Limits: 10...80%
Maximum Dew Point: +25°C

PM 9267/01 Data Hold Probe $150



PM 9267/02

Maximum Input Voltage: 30 kV
Attenuation: x1000
Input Impedance: 600 MΩ ±1%
Accuracy: ±2%
Temperature Coefficient: ±200 ppm/°C
Voltage Coefficient: ±0.5 ppm/V
Input Impedance Meter: 10 MΩ, 100 MΩ or 1.2 MΩ
Output Connectors: 2 x 4 mm banana plug

PM 9278/02 Ever-ready Case $75
PM 9279/01 Carrying Case $139

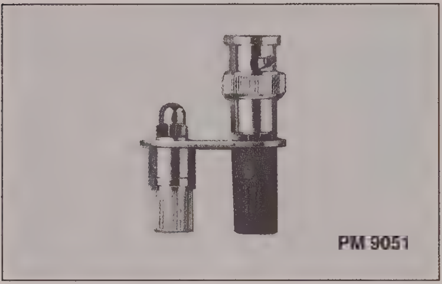
PM 9279/01

PM 9278/02

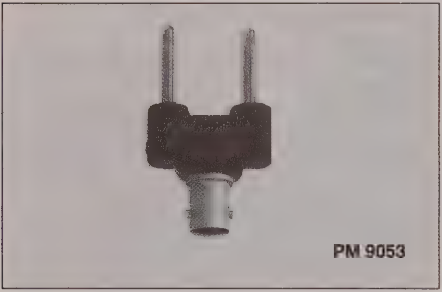
Sturdy shock resistant case with paddings on the inside, for shock absorption and space for accessories

Philips-Produced Accessories

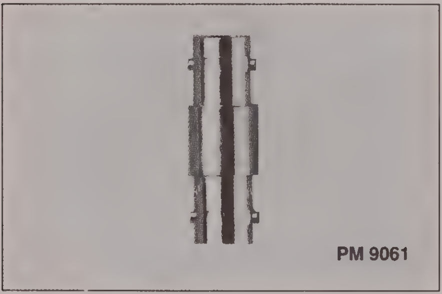
PM 9051 Adapter BNC (m) - banana (f) $9



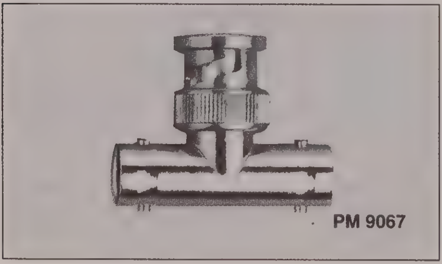
PM 9053 Adapter banana (m) - BNC (f) $14



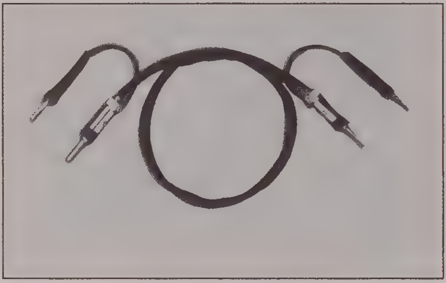
PM 9061 Adapter BNC (f) - BNC (f) $7



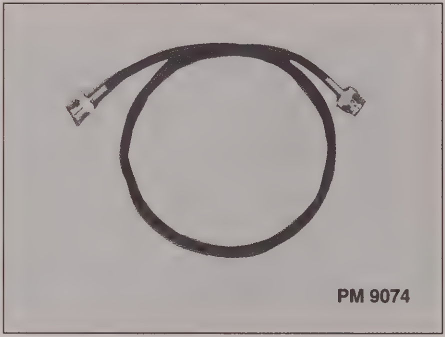
PM 9067 T-piece 1 x BNC (m) - 2 x BNC (f) $13



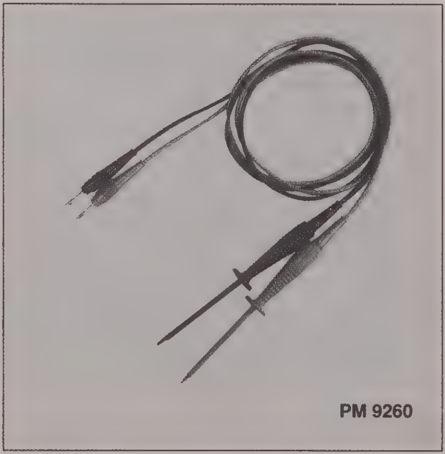
PM 9071 Measuring cable 135 Ω banana (m) - banana (m) $35



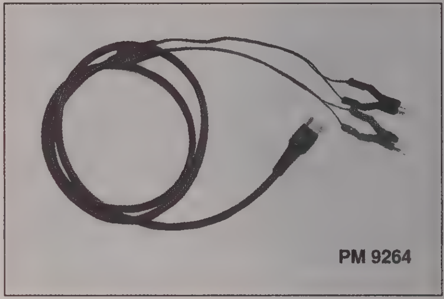
PM 9074 Measuring cable 50 Ω BNC (m) - BNC (m) $11



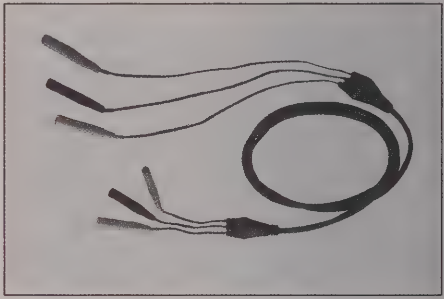
PM 9260/00 Set of test leads with probes $30



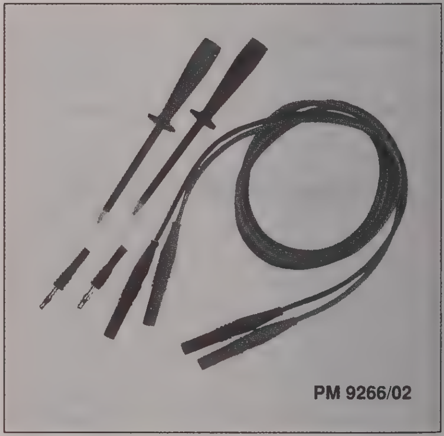
PM 9264/01 4-wire test leads/clips for resistance measurements $85



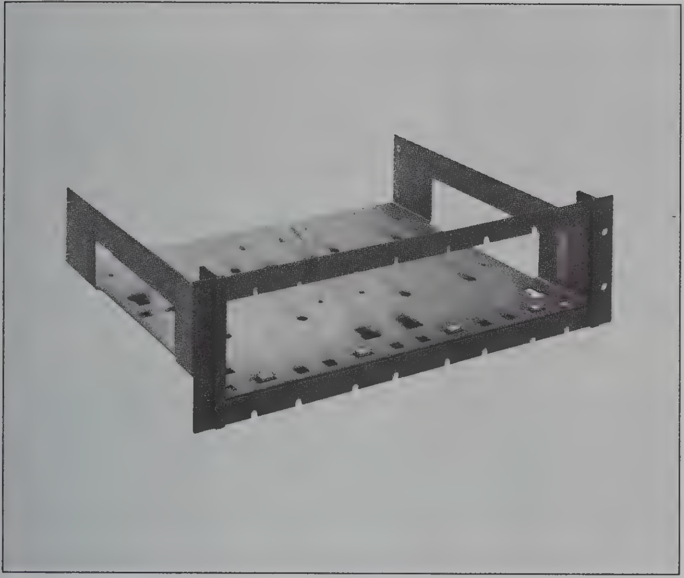
PM 9265/01 Shielded 3-wire test lead $110



PM 9266/02 Set of safety test leads with probes $39

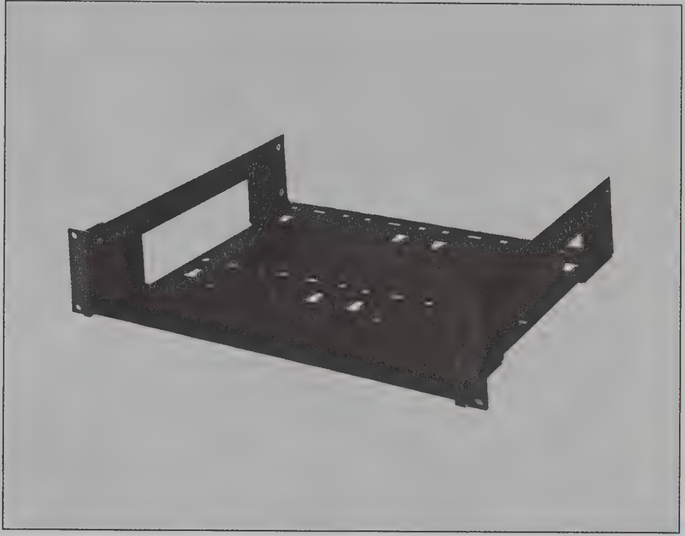


PM 2193/01 19-inch rackmount $275



Height: 3/E (133 mm 5.22")
Also fits PM 2525

PM 9280/02 19-inch rackmount $175



Height: 3E (133 mm 5.22")
Also fits PM 2534/PM 2535 and System 21

Rackmount Kit HM 9606/00 $95

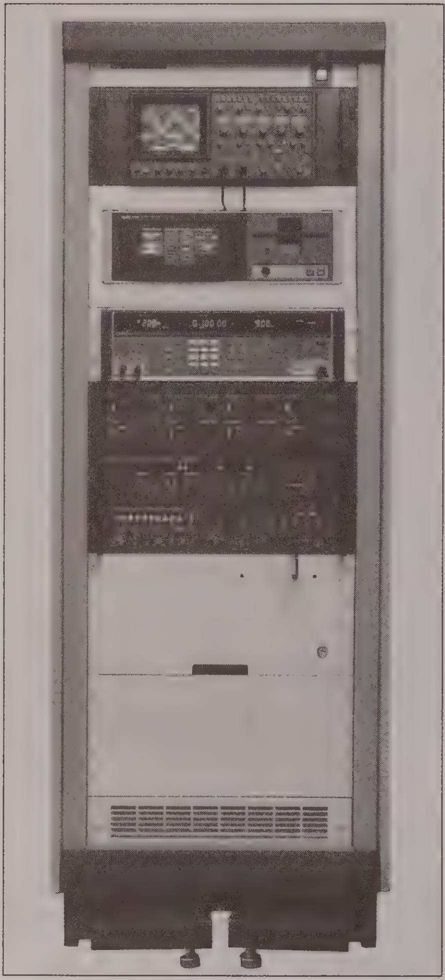
The HM 9606 rack kit is designed for use with the PM 2534/35 family of DMMs. The HM 9606/00 allows mounting of one PM 6665/6/9 Counter plus one PM 2534/35 DMM or one Fluke model 8840/42 DMM. The HM 9606/00 requires 5 1/4 inches of rack space. (See page 358 for photo).

Not available in North America

Philips-Produced Accessories

System 21 Modular GPIB/IEEE-488 Switching System

See page 380



System 21 is a modular range of switching, digital I/O, A/D and D/A units for GPIB-488 test systems. Their main application is in switching interconnections between the device under test and the instruments, controlled via the IEEE-488 bus.

GPIB/IEEE-488 Software

PM 2230 Series Instrument Drivers See page 376

PM 2240 TestTeam See page 374

TestTeam, together with instrument drivers, is a software package for the PC and PS/2 which greatly reduces development time for GPIB programs, and allows the user to take full advantage of the features of Fluke and Philips instruments.

Logic Analyzers

Page 153 PM 3655

Page 145 PM 3570

The Philips line of logic analyzer covers a broad range of applications including:

1. Low cost solutions for 8 Bit microprocessors.
2. Complete 32 bit support, including disassemblers for the Intel 80386, Motorola's 68020 and others.
3. Fast 100 Mhz x 96 channels state logic analysis to support RISC and bit slice designs.
4. 400 Mhz or 2.5 nanosecond transistional timing providing long time records and high resolution.
5. Multiple clocks to support mixed state and timing or multiple microprocessor designs.
6. Complete data qualification with both hardware qualifiers and range recognizers.
7. MS/DOS software to automate measurements and analysis for manufacturing applications or automated comparisons to design data.
8. Local Fluke support including fast service and services like:
    - a. Technical support
    - b. Seminars on digital testing
    - c. Classes on how and when to use a logic analyzer

The combination of outstanding basic specifications like minimum probe loading, short set up and hold times, low timing skew and abundant S/W packages for post processing make the Philips line a sure and complete solution. Add to that the local Fluke support and you'll find the best value per dollar in the industry for logic analysis.

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400 MHz 115 Channel

Logic Analyzer 145

Serial Data Pod 152

100 MHz 96 Channel

Low-cost Logic Analyzer 153

Accessories 158

Introduction

Logic Analyzers: Cost-Effective Tools for Digital Development

Today, there is a fast-moving trend for digital technology to replace analog in products in virtually every field; from washing machines and other domestic appliances to professional products and systems of every possible kind. Against this background, the right development and testing tools are absolutely essential in the product design process. It is no longer sufficient just to identify faults; their origins must also be located.

The ideal answer to this requirement is provided by the Philips range of logic analyzers.

These instruments offer powerful state and timing analysis capabilities to locate hardware and software faults; and on some instruments a combination of the two — a valuable feature during the critical hardware/ software integration process. Philips logic analyzers offer complete capabilities for analysis of hardware and software performance; in many cases all the user's problems can be handled by a single instrument.

Careful attention has also been given to ergonomic aspects of these high-performance instruments, ensuring that they are simple to use and easy to understand.

Suitable for All Applications

Philips logic analyzers are suitable for applications at all levels, from research and development, production, to field service and education. Each model offers both state and timing modes to give the user a total logic analysis capability, at clock speeds of up to 400 MHz for the top-of-the-range PM 3570 model.

Every type of applications is covered by the Philips range. Top models are the PM 3565/ PM 3570, two extremely advanced analyzers for systems-based applications, with 115 channels and a clock speed of up to 400 MHz, fully ready for 32-bit applications. The PM 3655 is a low-cost, full specification 100 MHz analyzer with 96 channels. This instrument has none of the performance trade-offs between speed, width and memory usually associated with instruments of this price.

Overviews of instrument set-up are displayed using a menu structure, showing at-a-glance the status of each measuring mode and considerably simplifying operation.

A variety of display formats, including a wide range of disassemblers for specific microprocessor types, allows the user to achieve the optimal display format for a particular application.

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Data Acquisition

For data acquisition from the system under test, Philips offers a selection of compact, lightweight test probes which do not mechanically strain the connection points. These probes present a very high input impedance of 1 Mohm to the test circuit, together with a very low capacitive load, so that they do not interfere with its normal functioning. A variety of probe types are available for easy connection to the test circuit, including touch, DIL clip, pin-grid, LCC (leadless chip carrier) or low profile. Test leads are color-coded for easy identification.

Varying threshold levels enable the analyzers to handle different logic families, including ECL, TTL, MOS and CMOS. The number of input channels varies according to the instrument — the PM 3570 has 83 dedicated state channels and 32 timing channels; the PM 3655 has 96 channels all available for state and timing analysis.

Data sampling can be either synchronous for state analysis, or asynchronous for timing analysis.

Data Storage

The logic analyzer's memory is an important performance factor: the memory must be large enough to store all parallel output data, and fast enough to handle the sampling rate required for a particular application or test system. The transitional memory principle used on the high-performance PM 3565 and PM 3570 instruments greatly increases the efficiency of memory utilization, making timing windows effectively much wider than on conventional instruments. The PM 3655 has a full 2 kbytes memory available on each channel, irrespective of the tasks being performed by the instrument, including glitch capture.

For state analysis, Philips PM 3565 and PM 3570 logic analyzers offer 1k-words of state analysis memory. Extensive qualification facilities optimize use of memory by enabling data sampling on only those system actions that actually need to be monitored. Qualification can be performed on clocks, words, triggers or blocks of data.

Versatile System Connection

Philips logic analyzers are controllable via RS-232 and GPIB interfaces allowing convenient use in PC-controlled environments. In these cases, individual user programs can be used for applications like watchdog system monitoring, and storage and retrieval of measurement set-ups and data on floppy or hard disk.

The PM 3655 not only has Centronics, RS 232 and IEEE-488 interfaces for system operation as standard, but is designed with all the functionality of a PC. Operation of the logic analysis functions is a menu driven and as familiar as a PC; in addition it can operate as a full function, MS-DOS PC with disk storage.

PM 3570 and PM 3565: Logic Analyzers for Tomorrow's Systems

With the PM 3570 and PM 3565 logic analyzers, Philips gives system engineers a powerful set of tools that meet the challenge of today's leading-edge technology. With no less than 115 channels and an extremely fast 400 MHz acquisition speed, they are ready to handle 32-bit development projects. With 35, 59 or 83 state channels, PM 3570 is a powerful and versatile instrument that covers most requirements for software testing and debugging.

Transitional timing analysis ranges from 32 channels at 100 MHz, 8 channels at 400 MHz or mixed-speed combinations. Dedicated personality adapters and family-oriented disassemblers provide support for 8-, 16- and 32-bit microprocessors. PM 3565 offers an entry-level configuration with up to 59 state and 16 timing channels.

PM 3655: The Full Function Low-Cost Logic Analyzer

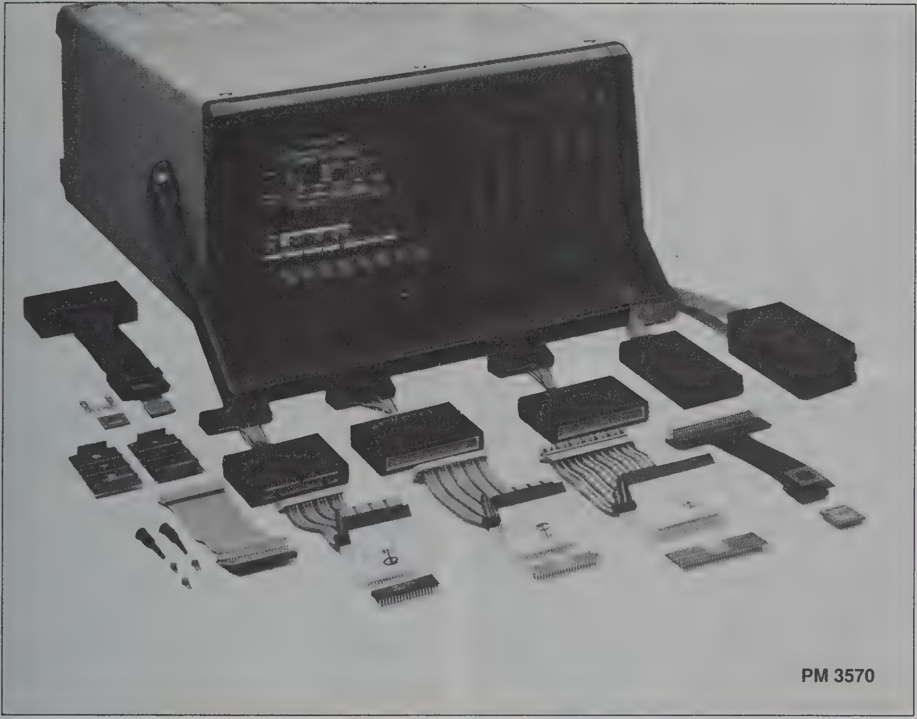
The PM 3655 offers a full 100 MHz sampling rate, synchronous or asynchronous, on all 96 channels, extremely fast for an instrument of this price. Moreover, using this full speed does not compromise performance of any other function. This is true of all the functions of this instrument — using glitch capture does not use any of the 2k bits of memory per channel or reduce speed; the PM 3655 operates at full speed and channel width, with glitch capture and retains 2k bits per channel.

Furthermore, it is expandable with a maximum of 4, 24-channel plug-in modules, allowing the user to specify exactly the power needed, while still having expandability assured. Also, operation is based entirely on the familiar PC, with normal keyboard, high resolution screen and menu-driven operation; and it also has a separate bus-architecture allowing it to function as an MS-DOS PC without affecting logic analysis capabilities.

PM 3565 & PM 3570

GPIB
IEEE-488

RS-232


PM 3570

PM 3565 & PM 3570 Logic Analyzers

- Configurable logic analyzer up to 115 channels
- 400 MHz transitional timing for infinite acquisition memory depth
- Time correlation mode between state and timing with dual screen display
- Performance analysis
- Wide range of 8, 16 and 32 bit microprocessor disassemblers
- Multi-level fully conditional triggering with selective data acquisition
- GPIB/IEEE-488 and RS-232C remote control interfaces

Keeping ahead of today's fast-moving technological advances demands the right development environment. Including the necessary tools to monitor every stage of the process: from the development and testing of hardware and software subsystems, right through to total-system integration and performance testing.

With the PM 3565 and PM 3570 Logic Analyzers, Philips gives system engineers a powerful set of tools that streamline and speed the development process. Tools that meet the challenge of today's leading-edge technology. Ready for 32-bit development projects with no less than 115 possible channels and ultra-fast 400 MHz acquisition.

State Analysis

Modular system upgrading for up to 115 state channels.

Transitional Timing Analysis

With a capability extending from 32 channels at 100 MHz up to speeds of 400 MHz, alternately usable as up to 32 additional state channels (for an unmatched total of 115 state channels).

Combi and Time-Correlated Modes

The photo shows time-correlated state and timing analysis with dual-screen display plus 32 channels simultaneously in state and timing modes without the need for dual-probing.

Performance Analysis

To optimize the speed of your code and monitor execution in real time, the PM 3570 and PM 3565 offer extensive performance analysis features. When more speed is needed, what sections of your code should you rewrite in assembly language? The PM 3570 and PM 3565 offers the tools to make the right choice the first time.

Transitional Timing

A Philips innovation that gets maximum mileage out of the logic analyzer's memory by capturing only those events that the operator wants to see. Transitional timing ensures that even the smallest pulses are captured, but without capturing the same information several times and wasting precious memory. For example, two 5 ns pulses, separated in time by more than 20 minutes, can easily be captured in a single acquisition shot!

Versatile Analyzer Configurations

As well as the ultra-high performance, 115-channel PM 3570 configuration, a simpler system configuration is also available as the PM 3565. This system covers up to 59 state channels and 16 transitional timing channels at 50 MHz, with four channels (also using transitional timing) switchable to 300 MHz. The PM 3565 configuration is ideal for 8-bit microprocessor system production testing and service applications.

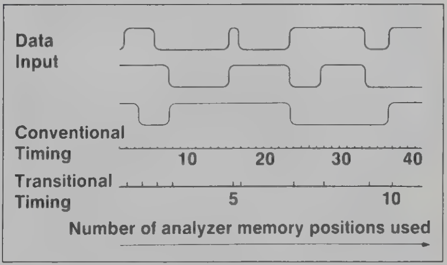
Broad Microprocessor Support

Philips has one of today's broadest ranges of dedicated subsystems for microprocessor support. Extending right up to the latest 32-bit devices, with support for newly introduced chips following fast.

Plus Fluke and Philips Worldwide Support

The PM 3570's tangible benefits in performance and technology are backed-up by renowned support. Based on our own know-how as a leading manufacturer and user of advanced microprocessor-oriented systems.

That know-how enables us to provide the user with the most advanced tools, as well as all the support needed to get maximum benefit out of the investment.



Both transitional and conventional timing analyzers give the same time resolution, but a transitional analyzer only uses memory in case there are changes on the data channels.

PM 3565 & PM 3570

Softkey Simplicity

One of PM 3570's most significant user features is its softkey simplicity. Eight softkeys, uniquely defined by adjacent on-screen labels, let the user enter instructions step-by-step.

These eight keys provide direct, easy access to over 300 different functions.

Future-Oriented Concept

PM 3570 and PM 3565 are part of a total future-oriented concept in logic analysis. Whatever application, it's virtually certain that these instruments will match it: whether it's state-oriented (8-bit, 16-bit and onwards), hardware-oriented (high-speed ECL), or both.

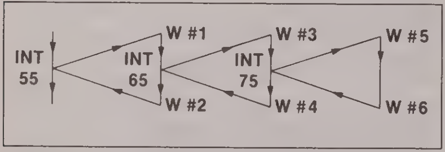
It is possible to expand up to 115 state channels, or 83 state channels plus 32 timing channels running at 100, 200 and 400 MHz.

State Analysis

PM 3570 provides a flexible, modular state analysis capability with up to 83 channels; starting with a standard 35-channel configuration and expandable in two further 24-channel steps. In addition, the high-speed 32-channel timing module can also be switched to state analysis, providing a total of no less than 115 state channels, usable for multi-channel testing applications.

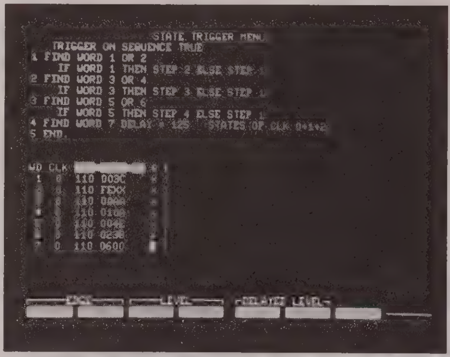
Trigger Menu

The operation of the trigger menu function is illustrated by this example of a three-deep priority interrupt on the 8085 processor. Here, WORD 1 identifies that the INT 5.5 service routine has been called, WORD 2 identifies the end of the routine. WORD 3 identifies the start of the INT 6.5 routine. If WORD 2 is encountered before WORD 3, the trigger if reset to step 1 to avoid a further INT 5.5 service routine. The same is true if WORD 4 is encountered before WORD 5, but the trigger is then set to step 2 to await the next INT 6.5 interrupt. PM 3570 is only triggered on WORD 6 when the full three-deep interrupt has occurred.That is, when INT 6.5. which is, in turn, interrupted by INT 7.5.

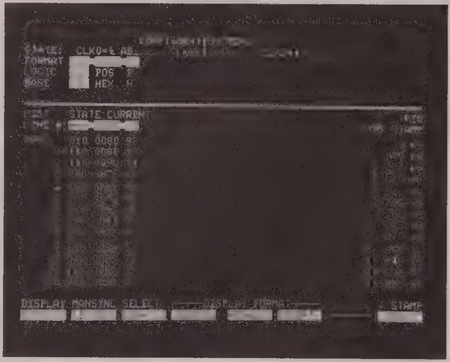


State List With Time-Stamping

In addition to versatile display facilities, it is also important to know which time intervals have elapsed between the consecutive states of the system under test. With PM 3570, it is possible to measure these elapsed times by time-stamping all the required states in the state list. Time-stamping can be absolute, i.e. starting from a defined starting point (trigger word) after which time runs cumulatively, or relative, in which the elapsed time of each state is shown individually.



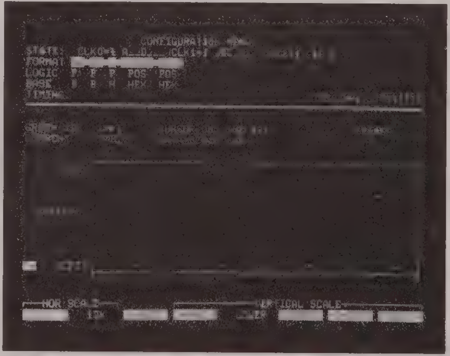
```
                    STATE TRIGGER MENU
  TRIGGER ON SEQUENCE TRUE
1 FIND WORD 1 OR 2
    IF WORD 1 THEN STEP 2 ELSE STEP
2 FIND WORD 3 OR 4
    IF WORD 3 THEN STEP 3 ELSE STEP 1
3 FIND WORD 5 OR 6
    IF WORD 5 THEN STEP 4 ELSE STEP 1
4 FIND WORD 7 DELAY = 125  STATES OF CLK 0+1+2
5 END.
```



State Graph Display

The graph display plots state analyzer memory contents against memory addresses — often useful for tracking overall software flow, or in monitoring analog-to-digital conversion. State graph display and state list are tightly coupled. As a result, moving the cursor in the graph display automatically co-scrolls the state list, and vice versa.

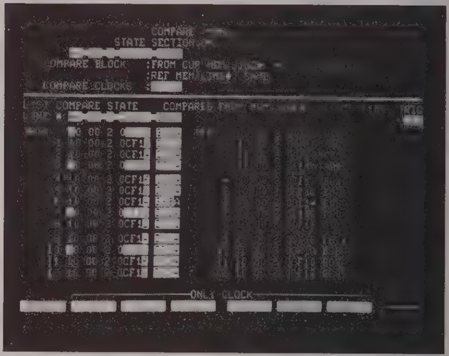
Recognition of repetitive loops or illegal memory accesses is much quicker than in a state list. So placing the cursor on a specific point of interest in the graph display, and then switching-over to the state list, directly reveals that area in terms of system state lines.



Compare Facilities

The PM 3570 provides sophisticated compare facilities for the fast location of system faults such as wrongly executed branches or incorrect data transfers. Data patterns of interest can be stored in reference memory, after which single- or multi-shot acquisitions of the new system data can be compared with the reference pattern.

Sections of the compared memory can be masked off and shifted, while further qualification is possible on a channel-by-channel or sampling-clock basis. Compared results are then displayed, with differences high-lighted in reverse video.

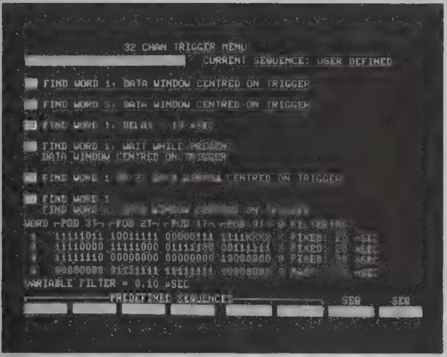


Transitional Timing Analysis

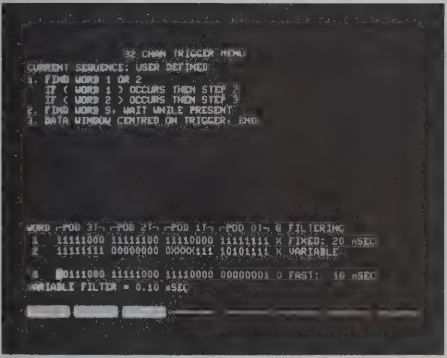
Philips' renowned transitional timing principle ensures optimal utiliaztion of available memory capacity by capturing only status changes; instead of conventional systems which capture data continuously, even when no events occur. PM 3570 has two separate memories; one for data and a second for time. If there is any change in one of the channels being examined between one sample and the next, the old data is loaded into the data memory, while at the same time the duration for which this data was valid is loaded into the time memory. PM 3570 therefore captures only the important transitions, even though it samples at constant intervals. Use of the transitional timing principle therefore enables PM 3570 to capture even the smallest pulses, without wasting valuable memory by repeatedly capturing unchanged data.

With a powerful, software-selectable choice of 32 transitional timing channels at 100 MHz, software-switchable to 16 channels at 200 MHz, 8 channels at 400 MHz, or combinations of these, PM 3570 has the capacity and versatility to handle every timing analysis requirement.

For example, a number of channels can be set to 100 MHz, while others are set to 200 or 400 MHz, giving a combination of these three sampling speeds at the same time. Working at 200 MHz allows detection of 7 ns pulses or glitches on 16 channels without any problem, while at sampling speeds of 400 MHz, pulses down to 5 ns or less can be captured on 8 channels. Powerful triggering is offered with four re-usable and independent trigger words of 32 bits each. Triggering is possible at any of the 3 available trigger levels at speeds of up to 400 MHz.



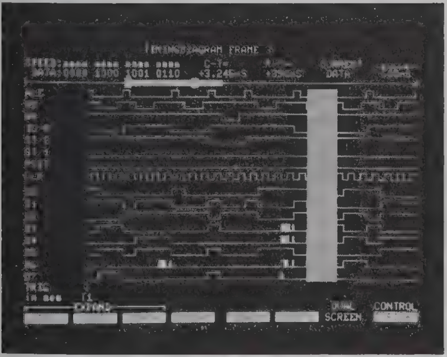
```
32 CHAN TRIGGER MENU
                    CURRENT SEQUENCE: USER DEFINED
FIND WORD 1, DATA WINDOW CENTRED ON TRIGGER
FIND WORD S, DATA WINDOW CENTRED ON TRIGGER
FIND WORD 1, WAIT WHILE PRESENT
DATA WINDOW CENTRED ON TRIGGER
FIND WORD 1
VARIABLE FILTER = 0.10 µSEC
```



```
32 CHAN TRIGGER MENU
CURRENT SEQUENCE: USER DEFINED
1. FIND WORD 1 OR 2
   IF ( WORD 1 ) OCCURS THEN STEP 2
   IF ( WORD 2 ) OCCURS THEN STEP 3
2. FIND WORD S, WAIT WHILE PRESENT
3. DATA WINDOW CENTRED ON TRIGGER, END

WORD ┌POD 3┐ ┌POD 2┐ ┌POD 1┐ ┌POD 0┐ Q FILTERING
 1   11111000 11111100 11110000 11111111 X FIXED: 20 nSEC
 2   11111111 00000000 0XXXX111 10101111 X VARIABLE

 S   00111000 11111000 11110000 00000001 0 FAST:  10 nSEC
VARIABLE FILTER = 0.10 µSEC
```



Timing Display Facilities

PM 3570's display facilities offer 4 available frames of any 16 timing channels to be displayed at the touch of a button for maximum user convenience. Of course, every timing channel can be preceded by a user-definable timing label, while a number of preset timing labels are also available. Timing reference measurements are easily carried out. All that is necessary is just to place the reference marker on desired edge, and move it to the next edge of interest. The measured time can then simply be read out to 5 decimal places! An important system attribute here is that a settable reference veil, indicating a specific time interval, can be moved right along the timing display. This allows quick searching of pulses of a specific length.

Cursor scrolling can be continuous or in discrete steps, such as edge-to-edge or page-by-page. The cursor can also be positioned immediately at a trigger word, as well as at the beginning or end of memory.

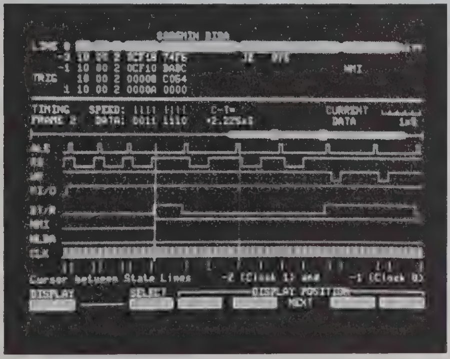
Time-Correlated Mode for Simultaneous State and Timing Analysis

As well as completely independent state and timing analysis sections, PM 3570 also allows both state and timing analysis sections to run together. This facility is particularly valuable in the hardware/software integration stage of a development project, when it is essential to check the interactions of system hardware and software, as well as for debugging and optimizing total-system performance.

In PM 3570's Combi mode, the state section can trigger the timing section, or vice versa; a powerful tool in determining true total-system behavior. It is also possible for one analyzer section to wait in its trigger sequence for the other analyzer section to proceed.

Analysis is extended even further in the selectable Time-Correlated mode in which the timing analyzer is running in synchronism with the state section. In this situation, state and timing displays are fully cross-referenced, so both state and timing conditions can be examined simultaneously at any specific moment in system operation.

The availability of a dual-screen mode allows both state information (disassembled if required) and timing waveforms to be shown simultaneously but with full cross-coupling. This allows superfast detection of errors by searching for irregularities in one part of the display, for example timing, and studying their effect on program flow in the other part of the display.

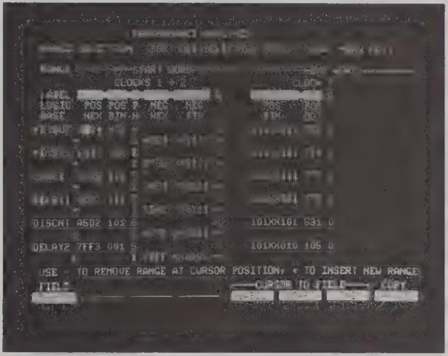


```
    -1 10 00 2 0CF10 DABC                 NMI
TRIG   10 00 2 00000 C064
     1 10 00 2 0000A 0000
TIMING   SPEED:
FRAME 2  DATA: 0011 1110   +2.225             DATA
Cursor between State Lines    -2 (Clock 1) and   -1 (Clock 0)
```

Performance Analysis

The PM 3570's performance analysis mode is essential in the final development phase after functional system testing has been completed.

Performance analysis monitors 12 sections of your code and presents an analysis, complete with graphics, as to which section code takes the longest time or is called most frequently. This tool quickly isolates where code should be optimized for faster operation

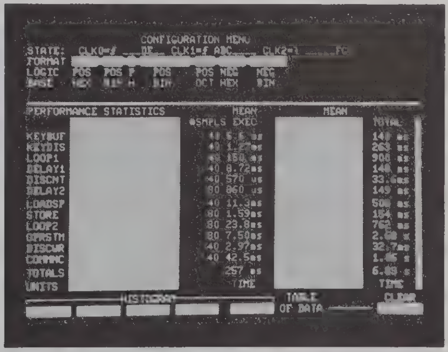


```
DISCNT A502 102              101XX101 S31
DELAY2 7FF3 001              101XX010 105
USE - TO REMOVE RANGE AT CURSOR POSITION, + TO INSERT NEW RANGE
```

Essential in Hardware/Software Integration

The task of the hardware development is to create hardware modules that match the electronics specification in terms of signal timing, levels, fan-in and fan-out etc. An important tool for the hardware team is a logic timing analyzer that offers at least 16 channels, and with sampling speeds of up to 400 MHz for high-resolution analysis.

Concurrently, the software development team will be writing all the code modules and linking them together.

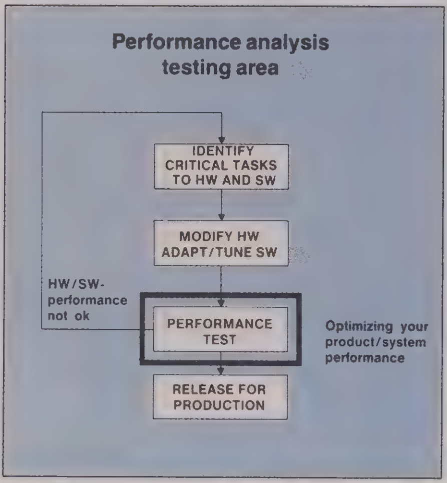


```
CONFIGURATION MENU
STATE:  CLK0=f    DF   CLK1=f ADC      CLK2=
FORMAT
LOGIC   POS  POS F  POS   POS NEG   NEG
PERFORMANCE STATISTICS        MEAN            MEAN
                        #SMPLS EXEC           TOTAL
KEYBUF
KEYDIS
LOOP1
DELAY1                   40 8.72ms
DISCNT                   40 570  us
DELAY2                   80 860  us           149 ms
LOADSP                   40 11.3ms
STORE                    80 1.59ms
LOOP2                    80 23.8ms
GPRSTM                   80 7.50ms
DISCUR                   40 2.97ms
COMMNC                   40 42.5ms
TOTALS                      257 ms
UNITS                       TIME              TIME
```

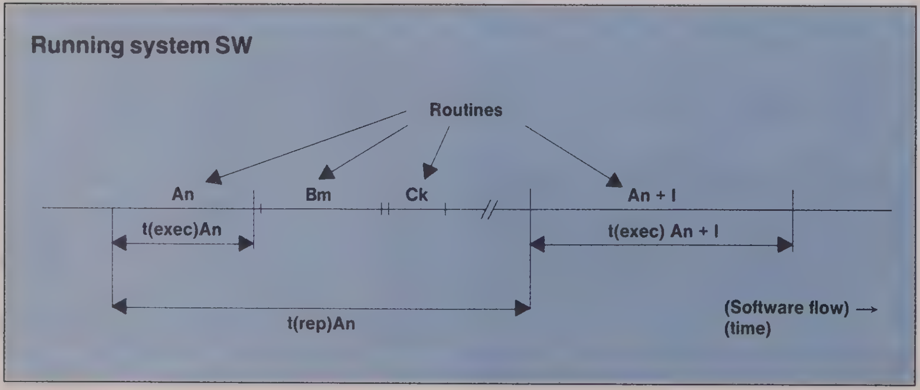
These separate activities are followed by the more difficult task of integrating hardware and software subsystems, either or both of which may then need further modification and testing. At this stage, an essential verification tool is the combined logic state and timing analyzer, offering sophisticated (synchronized) state and timing analysis, combined with full disassembly facilities.

Real finished-product software can be implemented after completion of the first working prototype with test software. Of course, it is essential to remove major system bugs, but this alone is not enough to ensure efficient and optimized system operation in accordance with the defined system tasks.

For example, it may be found that overall system run-times aims are not met, possibly due to the occurrence of long wait states caused by bottlenecks in the execution of system routines.


Performance analysis testing area
IDENTIFY CRITICAL TASKS TO HW AND SW
MODIFY HW ADAPT/TUNE SW
HW/SW-performance not ok
PERFORMANCE TEST
Optimizing your product/system performance
RELEASE FOR PRODUCTION

The diagram below shows a part of the program running in the system. Three routines are shown - A, B and C - together with an indication of execution time and repetition time for one of the routines. These execution and repetition times need not, of course, be constant. They can vary according to the level of system activity.



This allows a 'mean' execution time to be computed, giving a first indication of routine behavior. The mean is calculated by taking the average values of a selectable number of measured samples, for example 100, of either the execution or repetition time. Detailed measurements of execution/repetition periods of all 12 ranges can also be made, revealing important statistical information like minimum and maximum period values and standard deviations.

PM 3570's powerful combination of performance analysis facilities includes the following four operating modes:

- Event frequency, for measurement of the relative frequency of occurrence of a maximum of 12 address ranges
- Range period overview mode, for measurement of mean execution and repetition periods for a maximum of 12 ranges
- Range period overview mode, for measurement of individual execution and repetition periods for each range
- Complement period, for measurement of the time during which the system is active outside a maximum of four address ranges

Other special performance analysis features are 'ignore' and 'recursive routine' modes. Ignore mode allows an ignore word to be specified, which causes acquisitions passed through this word not to be merged with existing data. Measurements subject to interrupts can then be ignored, and the number of ignored events is also counted. The recursive routine mode enables repeatedly called routines to be recognized. This is not normally possible with other logic analyzers, which usually assume that a routine is ended after recognition of the END word. Up to 255 deep recursive routines can be recognized in this way, together with an indication of maximum and minimum values.

GPIB/IEEE-488* Bidirectional Control Interface

All logic analyzer functions are controllable at three distinct levels:

- Keyboard commands: all key operations can be simulated from a remote host
- Menu-level commands; complete sets of menu parameters can be set at once
- Instrument-level commands; all instrument parameters can be set at once

Of course, up- and downloading of instrument (reference) data are also possible via the IEEE-488 interface.

All bus communications are handled in accordance with IEEE-488/IEC-625 protocol, while service requests are handled by a complete, built-in control activated by the logic analyzer's operating system.

RS-232-C Bidirectional Control Interface

As with the IEEE-488/IEC-625 interface, all analyzer functions are controllable at the same three distinct levels of operation. Here again, up- and downloading of measurement (reference) data are also possible. All link communications according to the RS-232 standard are built in, together with a complete service request control system.

RS-232-C Printer Interface

Both the IEEE-488/IEC-625 and RS-232-C cards contain an additional, independent, RS-232-C printer interface which is provided for print dump output.

Printout can be handled in a number of ways:

- Printout listing of listed data per page
- Printout complete data listing
- Printout of all instrument menus
- Printout (hard copy) of any analyzer screen on a dot-addressed graphics printer (dedicated to Epson LX80/FX80/85 graphic printer types)

IBM PC-AT Interconnection

Remote control and post-processing of data are vital attributes in today's research and development environment. These tasks can be handled highly effectively by connecting the PM 3570 or the PM 3565 to a PC or work station, thereby providing access to powerful and versatile data processing and storage capabilities.

A software communications package is available for this purpose supports connection to the IBM PC and PC-AT, and compatibles. The package runs under the computer's PC- DOS (or MS-DOS) operating system, and provides complete remote control of PM 3570 from the PC-AT plus file-oriented storage of settings and measurement data on floppy or hard disk.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Specifications

Technical Specifications

State Modules

Input: Via PM 8821 or PM 8825 multi-lead active pods
PM 8821: 4.7 MΩ//6 pF
Max. Input Voltage: -50V...+50V
Max. Sensitivity: 250 mV threshold overdrive
Threshold: Selectable TTL, ECL or variable per pod
TTL: +1.4V
ECL: -1.3V
VAR: -3v...+12V in 100 mV steps

Clocks and Qualifiers

Three External Clocks
Min. Repetition Time: 50 ns
Min. Clock Pulse Width: 15 ns
Up To Four Clock Qualifiers
Set-Up Time: 12 ns, with respect to active clock edge
Hold Time: 0 ns, with respect to active clock edge

Memory

Depth: 1023 words
Width: 35 bits or 59 bits or 83 bits. Reference memory of similar size

Triggering

Trigger Words: 7 words of 83 bits max.
No. of Trigger Levels: 7
Trigger Modes: Sequential, conditional, on-sequence-break
Trigger Source: From state, from timing, external

Selective Data Acquisition

Sections Between Trigger Words
Sections of Words A, B With/Without Delay
A, B Word Width: 83 bits max.

32-Channel Timing Module

Input: Via PM 8826 dual timing pods, 1 MΩ//5 pF
Max. Input Voltage: -50V...+50V
Max. Sensitivity: 200 mV threshold overdrive
Threshold: Selectable TTL, ECl, or variable
TTL: +1.4V
ECL: -1.3V
VAR: -3...+12V in 100 mV steps

Clock and Qualifiers

Clock Source: Internal, external or from state

Channel Speed Configurations With Internal Clock

32 Channels at 100 MHz: (Sample interval 10 ns)
16 Channels at 200 MHz: (Sample interval 5 ns)
8 Channels at 400 MHz: (Sample interval 2.5 ns) Plus 22 mixed 100/200/400 MHz channel/speed configurations
Storage Mechanism Transitional
Memory Depth: 256 to 512 x 10^6 samples, 1024 to 131 x 10^9 samples (optional)
Max. Recording Time: 5 min.; 22min. (optional)
Reference **Memory:** Same values
Glitch Capturing: 4.7 ns
Max. Undetected Pulse: 4.7 ns
Channel-to-Channel Skew: 2 ns
Triggering: 4 independent words of 32 bits + 1 external trigger bit
Trigger Levels: 3, either sequential or conditional
Trigger Source: From timing, from state, external
Glitch Triggering: Via timing triggering
Triggering Time Delay: From 0 ns to 335 ms
Final Trigger Delay: PRE, CENTER, POST

Channel Speed Configurations With External Clock

32 Channels at 100 MHz Max: Asynchronously
Max Memory Depth: As with internal clock (transitional)
31 Channels at 50 MHz Max: Synchronously
Clock Qualifiers: 4
Memory Depth: 512 samples, 2048 samples optional

8-Channel/50 MHz Timing Module

Input: All inputs via PM 8825 multi-lead active pod
Input Impedance: 1 MΩ//5 pF
Max. Input Voltage: -50V...+50V
Max. Sensitivity: 200 mV threshold overdrive
Threshold: TTL, ECL or variable
TTL: + 1.4V
ECL: - 1.3V
VAR: - 3V to + 12V in 100 mV steps
Clock: Internal, fixed 20 ns sampling rate 8 channels, 50 MHz
Storage mechanism transitional
Memory Depth: 256 to 256 x 10^6 samples
Reference Memory: Same values
Max. Undetected Pulse: 24 ns
Channel-to-Channel (pod) Skew: 2 ns
Min Detectable Glitch Width: 5 ns on 8 channels
Triggering: On all data channels + 1 external trigger bit, from state
Trigger Modes: On word, on glitch in word, on glitch in window
Trigger Time Delay: From 0 ns to 20 ms
Final Trigger Delay: From 0 to 255 transitions

4-Channel/300 MHz + 8-Channel/50 MHz Timing Module

Input: As for 8-channel/50 MHz timing module
Clock: Selectable between 300 MHz (3.3 ns) or 50 MHz (20 ns)
Memory Depth: 256 to 256 x 10^6 samples (50 MHz); 1536 to 128 x 10^6 samples (300 MHz)
Reference Memory: Same values
Max. Undetected Pulse: 5.5 ns
Channel-to-Channel (pod) Skew: 2ns
Min. Detectable Glitch Width: 5.5 ns
Triggering: From timing, from state
Trigger Time Delay: From 0 ns to 20 ms
Final Trigger Delay: PRE, CENTER, POST

RS-232-C Printer Dump Interface

Prints alphanumeric data to any RS232-compatible printer. Prints graphic data to Epson FX80, or compatible printer
Format: 1 start bit, 7 data bits, 1 parity (E), 1 stop bit
Speed: 110, 150, 300, 600, 1200, 2400, 4800, 9600 bits/s

RS-232-C Control Interface

Format and speed for RS-232 printer interface
Modes: Load and dump with PM 4202 cassette drive full control with any RS232 control unit, (host PC)
Control Levels: Key level, menu level, instrument level
Data transferred can be instrument settings and/or reference data
Separator: CR, NL, CRLF (default), EXT, ETB

IEEE-488/IEC 625 Interface

Implements SH1, AH1, T6, L4, SR1, RL1, DC1, DT1
Control Levels: Key level, menu level, instrument level
Data transferred can be instrument settings and/or reference data
Separator: CRLF and EOI default, CR, LF, ETX, ETB
Transfer Speed: 1 KB/s

General Specifications

Video Output: Composite video output standard; 50 Hz refresh, BNC connector; 1V peak-to-peak into 75Ω
PowerSupply: 110, 127, 220 or 240V AC ±10%; 50/60 Hz ±10% (400 Hz on request). Conforms to IEC 348 safety class I and ECMA 57 requirements. Power Consumption 550 VA (max.)

Ambient Temperatures
Rated Range of Use: +5°C...+40°C
Operating: -10°C...+55°C
Storage and Transport: -40°C...+70°C

Altitude
Operating: <5,000m (16,400 ft.)
Not Operating: <15,000m (49,200 ft.)

Humidity
Operating: 20%...80% RH (non-condensing)
Not Operating: 5%...95%\
Electromagnetic Interference: Conforms to VDE 0871, Level N - 12 dB
Recovery Time: Operates within 30 minutes after - 10°C soak, going into 60% RH at + 20°C room conditions
Size: 237 mm H incl. feet, 450 mm W plus handle, 600 mm D incl. backstanders plus handle (9.3 in H incl feet, 17.7 in W plus handle, 23.6 in D incl backstanders plus handle
Weight: 18 kg (39.4 lb) approx.Operation

PM 3565 & PM 3570

Operation

Menus

Upon menu selection, all parameters are entered by softkey and hex pad. User prompting and error messages appear on the screen. The menus are:

Configuration: The organization of clocks, clock qualifiers, channels, thresholds and state labels, as well as sampling speed (timing) and polarity

Triggering: The definition of the point at which data acquisition is to stop

Selective Data Acquisition: The definition of which data from the data stream is to be captured

Compare: The definition of which data is to be compared in the main and reference memories

Option: The selection of a required disassembler and parameter setting of the RS-232 printer interface, RS232 control interface and the IEEE control interface

Performance Analysis

Built-in as standard. Divides code (system SW) into max. 12 ranges, identifiable by start and end of word in Range Selection Menu

Modes of Operation

- Event frequency for occurrence of ranges; min. repetition time: 50 ns
- Range period for (averaged) execution and repetition times with minimum and maximum values plus standard deviation
- Complement period for range period of system activity outside max. four selectable ranges

Special Features

Ignore: Exclusion of exceptional/spurious events

Continue: Recognition of recursive routines

Data Displays

List: Listing of state/timing captured data

Time: Displays a waveform diagram (timing diagram) representing the contents of the timing analyzer memories

Graph: XY-oriented display plotting memory contents against address values

Table: Tabular representation of event frequency, mean execution, repetition and total time period data (performance analysis)

Histogram: XY-oriented bar graph representing event frequency, execution (mean) period, repetition (mean) period, total time and complement period data. Histogram of recursion depth (performance analysis)

Data Display with Compare

List: Irregularities between current and reference memories are highlighted

Time: Irregularities between current and reference memories are underlined

Non-Volatile Memory Facilities

Stores up to four user settings; last setting always saved after power-down. Stores all available state/timing reference data, including performance analysis results.Built-in as standard.

Universal Disassembler Option

Universal disassembler package with four user-definable dissassemblers in case no particular disassembler from the above table applies. Useful for disassembly of military CPUs, bus systems, etc. User can specify e.g.:

- Disassembler name (9 characters per dissassembler name)
- PM 3565/70 configuration incl.clocks, qualifiers
- Translation table and mnemonics (max. 256 per disassembler)

Delivered as normal disaboard with one empty socket. All user-defined data to be stored in one 2764 which fits in socket. Two 2764s are supplied: one empty, another with example disassemblers (e.g. IEEE-488 bus). Max. 4 disassemblers packs (EPROM boards) can be installed per instrument.

Personality Adapters (Also see page 158)

To allow easy target clip-on connection to PM 3565/70, compatible with PM 8821, PM 8825 and PM 8826 pods. Two hard-wired types are available:

PM 8817/40: 5 pods to 40-pin DIL clip

PM 8817/64: 8 pods to 64-pin DIL clip

Prewired personality adapters are available for many microprocessor types. See list above. All pluggable parts of PM 8817/XX can be ordered separately.

PM 8816/XX: Personality housing for

PM 8817/XX: same range as PM 8817/XX

PM 8815/40: 40-pin DIL-clip with flat cable and connector (to PM 8816/XX)

PM 8815/45: 40-pin DIL low-profile (12 mm height) with flat cable and connector (to PM 8816/XX)

PM 8815/48: 48-pin DIL-clip with flat cable and connector (to PM 8816/XX)

PM 8815/64: 64-pin DIL-clip with flat cable and connector (to PM 8816/XX)

PM 8815/65: 64-pin DIL-clip low profile with flat cable and connector (to PM 8816/XX)

PM 8815/68: 68-pin grid array front-end with flat cable and connector (to PM 8816/XX)

PM 8815/70: 68-pin grid array front-end with flat cable and connector (to PM 8816/XX) (Intel Version)

PM 8815/71: Pin grid to Lcc converter

PM 8815/72: 114-pin grid array front-end with flat cable and connector (to PM 8816/37)

PM 8815/00: five pod noses allowing connection of PM 8821 /25 /26 pod to PM 8816/XX (personality housing)

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Ordering Information

Models	January 1989 prices
PM 3565 Logic Analyzer	$3750
PM 3570 Logic Analyzer	4000

Options

PM 8853/60 Logic State Module 35 channel/20 MHz	3000
PM 8853/50 Logic State Module 24 channel/20 MHz	2000
PM 8853/70* Logic State Module 24 channel/20 MHz	2000
PM 8853/30* High Speed Timing Module, 32 channels, 100/200/400 MHz, 1/2 kB mem.	6000
PM 8853/90* High Speed Timing Module, 32 channels, 100/200/400 MHz, 2 kB mem.	9000
PM 8852/70** Logic Timing Module, 8 channels, 50 MHz	2500
PM 8853/80** Logic Timing Module, 8 channels/ 50 MHz, 4 channels/ 300 MHz	3500
PM 8856/20* RS232 Control	750
PM 8856/30** RS232 Control	750
PM 8856/40* IEEE Control	750
PM 8856/50** IEEE Control	750
PM 8821 8-Channel State Probe	350
PM 8825/10 8-Channel Fast Timing/ State Pod	500
PM 8826* 2 x 8-Channel Dual Timing Pod	1000
PM 8827* 32 Channel Single Probing Adapter	500

Accessories (Also see page 158)

PF 8701 General Purpose Software Communications Package	200
PM 8811 Serial Data Pod	1195
PM 8819 Extension Kit	75
PM 8819/10 54 Colored Leads	75
PM 8819/20 35 Measuring Clips (black)	75
PM 8819/30 50 Mini Clips (red)	75
PM 8819/40 54 Colored Leads	75
PM 8819/50 54 Colored Leads	75
PM 8893 Protective Front Cover	40
PM 8991/04 Cart	450
DL 3633 Pouch	50

**for PM 3570 analyzer only*

***for PM 3565 analyzer only*

Service & Support

Warranty

One-year warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see page 491.

Microprocessor Support

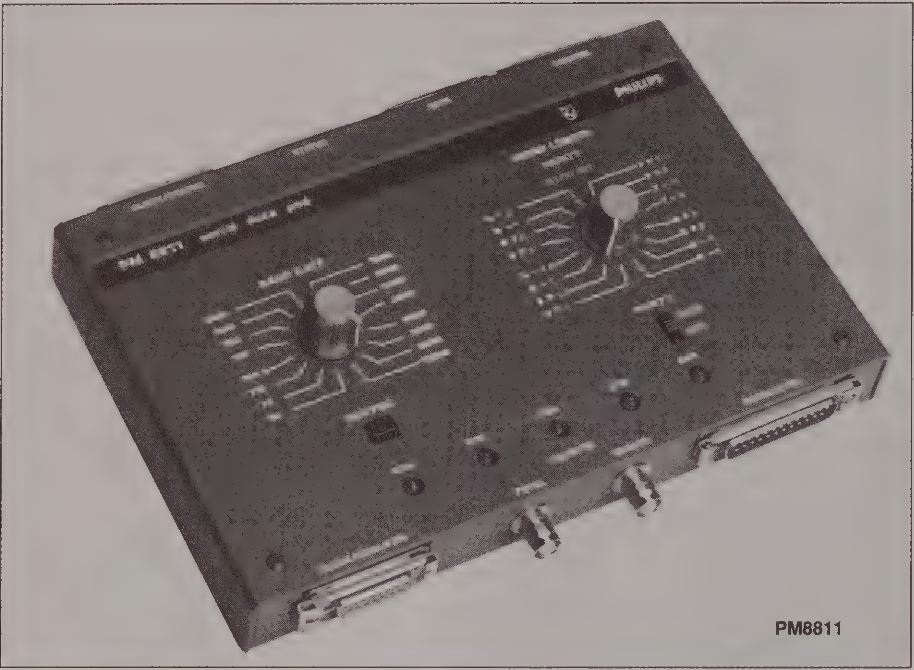
Type		Disassembler package	Personality adapter	Front-end
Motorola	6800	PM 8858/00 (M1 pack)	PM 8817/10 PM 8816/10	40-pin DIL 40-pin LCC
	6802/6808	PM 8858/00 (M1 pack)	PM 8817/10 PM 8816/10	40-pin DIL 0-pin LCC
	6809 6809E	PM 8858/00 (M2 pack) PM 8858/00 (M1 pack)	PM 8817/26 PM 8817/26	40-pin DIL 40-pin LCC
	68000, 68010	PM 8858/10 (M2 pack)	PM 8817/19 PM 8816/19 PM 8817/36	64-pin DIL 64-pin LCC 64-pin grid array
	68008	PM 8858/20 (M3 pack)	PM 8817/32 PM 8816/32	48-pin DIL 40-pin LCC
	68020	PM 8858/30 (M4 pack)	PM 8817/37 PM 8816/37	114-pin grid array 114-pin LCC
	68HC11	PM 8858/90 (M5 pack)	PM 8817/68	52-pin PLCC
Intel	8080	PM 8858/40 (N1 pack)	PM 8817/28 PM 8816/28	40-pin DIL 40-pin LCC
	8085	PM 8858/40 (N1 pack)	PM 8817/20 PM 8816/20	40-pin DIL 40-pin LCC
	8031/51	PM 8858/40 (N1 pack)	PM 8817/30	40-pin DIL
	8035	PM 8859/40 (X pack)	PM 8816/30	40-pin LCC
	8048	PM 8859/40 (X pack)	PM 8817/40	40-pin DIL
	8086/8088 min./max.	PM 8858/50 (N2 pack)	PM 8817/27 PM 8816/27	40-pin DIL 40-pin LCC
	80186	PM 8858/60 (N3 pack)	PM 8817/31 PM 8817/34 PM 8816/31 PM 8816/34 PM 8817/38	68-pin LCC 68-pin grid array 68-pin LCC 68-pin grid array 68-pin LCC and 68-pin grid array
	80286	PM 8858/70 (N4 pack)	PM 8817/35 PM 8816/35 PM 8817/39	68-pin grid array 68-pin LCC 68-pin LCC
	80386	PM 8858/80 (N5 pack)	PM 8817/41	132-pin grid array
Zilog	Z80	PM 8859/20 (Z pack)	PM 8817/22 PM 8816/22	40-pin DIL 40-pin LCC
Rockwell	6502, 6512	PM 8859/30 (R pack)	PM 8817/24 PM 8816/24	40-pin DIL 40-pin LCC
NS	NSC 800	PM 8859/30 (R pack)	PM 8817/12 PM 8816/12	40-pin DIL 40-pin LCCm
Universal adapter			PM 8816/40 PM 8817/64 PM 8816/64	40-pin LCC 64-pin DIL 64-pin LCC
Custom		PM 8859/10 (B pack)	User selectable	User selectable
disassembler (1)		PM 8859/00 (C pack)	User selectable	User selectable

(1) Universal disassembler package with four user-definable disassemblers in case no particular disassembler from the above table applies. Useful for disassembly of military CPUs, bus systems, etc.
User can specify e.g.:
- *disassembler name (9 characters per disassembler name)*
- *PM 3565/3570 configuration incl. clocks, qualifiers*
- *translation table and mnemonics (max. 256 per disassembler)*

Delivered as normal disaboard with one empty socket. All user-defined data to be stored in one 2764 which fits in socket. Two 2764s are supplied: one empty, another with example disassemblers (e.g. IEEE-488 bus). Max. 4 disassembler packs (EPROM boards) can be installed per instrument.

PM 8811

RS-232



PM8811

PM 8811 Serial Data Pod

- Enables logic state analyzers to monitor RS-232/V24 data lines
- Both TX and RX data captured
- Adjustable speed and character formats
- LED indication of control line status

The PM 8811 serial data pod enables a parallel data sampling logic state analyzer to monitor the serial asychronously transmitted data present on RS-232C/V24 communication lines. By means of its front panel switches, the PM 8811 is easily adjusted to cope with all common transmission formats found on RS-232C lines. These enable word lengths of 5, 6, 7 or 8 bits with odd, even or no parity bits. 1, 1.5, or 2 stop bits may be selected and the 16-crystal controlled speed settings ensure accurate data capture.

Connection to the RS-232C/V24 line is simply made using the supplied special 'T' connector. The high input impedance of this pod avoids any possibility of excess line loading which could result in erroneous measurement.

PM 8811 monitors both the TX (PIN 2) and RX (PIN 3) lines simultaneously. This capability permits the action and immediate reaction of a system to be followed and, for example, enables rapid identification of 'echo' faults.

Framing error and parity error faults are also identified by the PM 8811. In addition the two BNC outputs enable a counter to be connected so that simple error rate measurements can be made.

Should multiple consecutive errors be identified by the PM 8811 it is possible that, via some other fault condition, synchronization with the RS-232C/V24 line being monitored has been lost. To overcome this the PM 8811 will automatically re-synchronize itself. It is also possible to manually re-synchronize the PM 8811 by pressing the RESYNC button. The status of the RTS, CTS, DSR, DTR and DCD control lines are indicated by means of five LEDs. This information is also available at one of the output connectors should it need to be monitored in conjunction with the captured serial data.

Serial data triggering and data display is dependent on the logic analyzer with which the PM 8811 is used.

Specifications

Specifications refer to both TX and RX inputs of the PM 8811

Speed: Selectable at 50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600 and 19,200 bits/s
Character Length: Selectable 5, 6, 7 or 8 bits
Parity: Selectable odd, even or none
Stop Bits: 1 or 2 bits for 6-, 7- and 8-bit characters; 1 or 1.5 bit for 5-bit characters
Input Impedance: 21 MΩ/<50 pF
Threshold: 0V
Sensitivity: ±3V threshold overdrive
Total BNC Output: Gives TTL output pulse on each character
Error BNC Output: Gives TTL output pulse on error characters
Power Requirements: +12V <10 mA; +5V <200 mA; -12V <10 mA (supplied from logic analyzer)
Size: 215 mm W x 45 mm H x 160 mm L (8.5 in W x 1.8 in H x 6.3 in L)
Weight: 0.75 kg (1.6 lb)
Included: T connector for connection to RS-232/V24 interface; Instruction Manual

Ordering Information

Models

January 1989 prices

PM 8811 Serial Data Pod for PM 3565/PM 3570 .... $1195

Service & Support

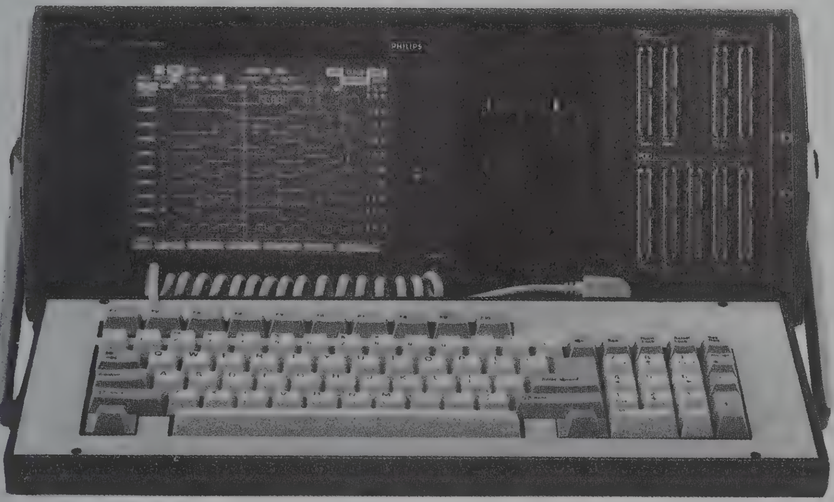
Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

PM 3655

GPIB
IEEE-488

NEW



PM 3655

PM 3655 100 MHz 96 Channel Low-cost Logic Analyzer

- Full 100 MHz sampling speed on all 96 channels for timing and state analysis
- 2k bits of memory always available on all 96 channels
- 5 ns glitch capture on all channels, at full 100 MHz and with full 2 kbits memory
- Sophisticated multi-level triggering and 4 clock qualifiers
- High quality, high impedance probes
- Supports 8-, 16-, 32-bit micros and RISC architectures
- Modular design: field installable 24-channel modules
- Easy, familiar operation
- MS-DOS PC functionality

The PM 3655 is a low cost logic analyzer offering very powerful performance, always fully available regardless of the combination of functions in use, or the application. The user need make no compromise in performance demands - sampling speed is 100 MHz on all channels with no width or depth trade-offs; the full 2k bits memory per channel is always available; and the glitch capture does not reduce the speed or use any memory.

The PM 3655 offers the kind of performance not usually available in low-cost logic analyzers. This has been achieved with high performance ECL technology. Although it required greater effort in optimizing the design to obtain this high performance, ECL imposes none of the compromises at high speed associated with MOS.

Full Performance

The PM 3655 offers an extremely fast sampling rate for an instrument in this price class: 100 MHz on all 96 channels (synchronous and asynchronous), at full channel width performance that handles the latest micro technology, as well as preparing you for the next generation.

For capture of complex data flows or extended timing analysis, each channel has 2k bits memory, available with full channel width at full speed, even when glitch capture is in operation.

The 5 ns Glitch mode allows capture of very brief transients - again at full speed on all channels, with no loss of width or depth.

Triggering is comprehensive, so the user can find exactly the data required, and includes a powerful multilevel trigger word sequencer, true range recognition and 4 clock qualifiers. An Area Trace facility also serves to effectively extend memory.

These high performance levels also include the probes, which are high spec high impedance, so they do not distort signals or mask glitches.

Modularity

The PM 3655 has a maximum of 4 plug-in modules, each of 24 channels, giving the user a maximum of 96, with each channel capable of state and timing analysis at the full 100 MHz. Thus the user need not buy more power than needed, but is still assured of future expansion. A wide range of micro-specific disassemblers and personality adapters is available, for reduced effort in set-up, and this range is constantly being expanded.

Simple, Familiar Operation

Operation of the PM 3655 is based on the familiar PC. It is menu driven; entry is via a normal keyboard with display of up to 24 channels simultaneously on a high-resolution screen; and the user can define channel labels or trigger words. It also has on-line disk storage, with full HELP and tutorial facilities supplied on disk.

Plus PC Functionality

Also, to make it a real added-value instrument, the PM 3655 can function as a full MS-DOS based PC, with a completely separate bus-architecture that does not limit any of the logic analysis capabilities. In addition to the 5 1/4" disk drive, 4 expansion slots are provided for LAN cards, internal modems, memory expansion and so on. Instrument set-ups can be stored on disk for later use, and measurement data can also be stored for later analysis, on a different machine if necessary. PM 3655 will run additional MS-DOS software such as word processing packages, increasing the versatility even further. It has Centronics, GPIB/IEEE-488* and RS 232 interfaces as standard.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3655

100 MHz State Analysis on 96 Channels

In state analysis, logic analyzers synchronize data acquisition using clock signals from the target. If the acquisition speed of the analyzer is too slow for the target clock, real time state analysis is impossible, so the speed of the analyzer is critical in determining its range of application.

The PM 3655 logic analyzer can perform state analysis at 100 MHz on up to 96 channels. This provides a safe operating margin not only for the analysis of designs with today's modern microprocessors, which are already operating at speeds of up to 30 MHz, but not for tomorrow's higher speed processors. Indeed, the combination of clock speed and number of channels make the PM 3655 suitable for the analysis of 8-, 16-, and 32-bit applications, including the up and coming RISC architecture CPUs, ECL gate arrays and fast bit slice designs. And this doesn't mean for just some designs - set up and hold times of 2.5 ns ensure samples are correctly taken and all trigger word recognizers run at 100 MHz, for all applications.

96 Channels in Groups of 24

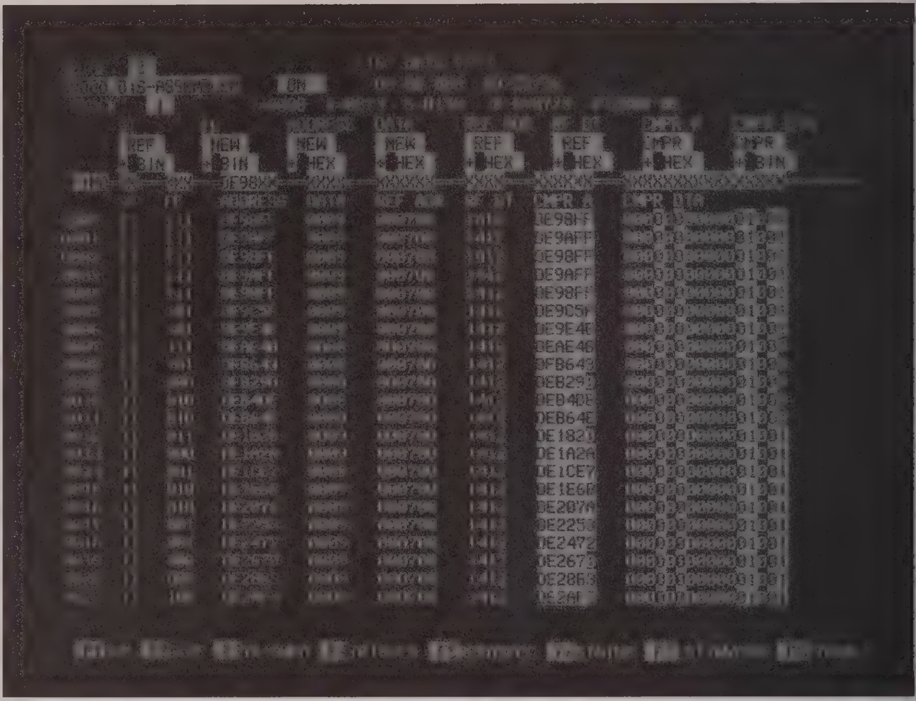
The modular design of the PM 3655 allows you to start with the minimum number of channels to satisfy your needs for simple timing and state applications, and add in extra cards to provide a maximum of 96 channels as your applications become more sophisticated. Each field installable 24 channel card, can be operated as an independent or interdependent logic analyzer for extra versatility. Each card can use a unique clock, clock qualifier and trigger; or the same clock qualifiers even when they are using different clocks. For added flexibility, different pre- and post-triggering parameters can be set for each card.

Powerful Triggering

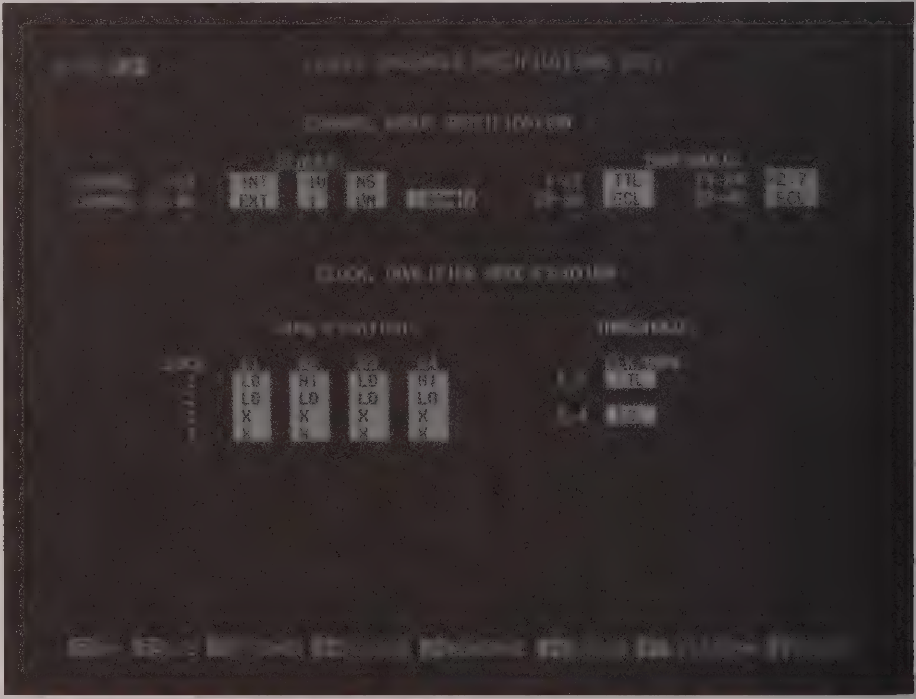
The PM 3655 can check for 4 trigger conditions and can simultaneously check for occurrence of 3 different trigger words from a choice of 12. Branching can be to the next or to a previous level; destination can be set individually per trigger word. Trigger words can be set to monitor up to 96 channels, i.e. over the full width of the analyzer.

Data acquisition can be stopped on any or all of the 24 channel modules, on any of 4 trigger levels. This allows both the cause of an error and the consequences to be captured by triggering different groups of channels, at different trigger levels.

A unique TIME-OUT triggering function can be defined on each trigger level, which locks in on events occurring within a user-specified time interval. If the events programmed on that trigger level do not occur within the pre-defined time limit, the TIME-OUT will activate and cause the trigger sequencer to proceed to another trigger level.



1. This state display highlights the differences between new acquisitions and reference memory, and also illustrates the wide number of channels that can be seen at once. The FIND feature allows a search for a specific word in memory.



2. Clock and threshold specifications allows clocks to be assigned to the 24 channel cards and thresholds to be set for ECL, TTL or variable. Four qualifiers can be allocated to each clock. Modules function as independent — or interdependent — logic analyzers in either state or timing modes.

2 kbit Memory Depth per Channel

Each channel in the PM 3655 can record an ample 2 kbits of states or events, providing long traces of, for example, a microprocessor's instruction flow.

The trigger position can be set at any position in the data memory and can be programmed to a one-sample resolution. Trigger position can be set to a different value for each of the 24 channel blocks, allowing from 2 kbits of pre-trigger data to 2 kbits of post-trigger data to be captured.

Using the trigger delay function (up to 65334 clocks/events), events occurring long after the trigger can also be captured.

Area Trace

By programming the PM 3655 to record only specific information, memory capacity can be optimized. Upper and lower range recognizers can be enabled or disabled on each of the 4 trigger levels. When the range recognizers are enabled, the analyzer will only record values that fall within the selected ranges and all others will be discarded. Not only does this make more efficient use of available memory, it also allows you to concentrate on only relevant data.

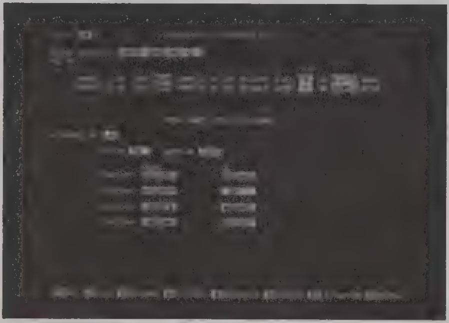
100 MHz Timing Analysis on 96 Channels

Each of the 24 channel groups can be used to perform timing analysis. All 96 channels can run at 100 MHz and the 2 kbit memory on each channel combines high resolution with a minimum of 20 µs recording length at the fastest clock speeds. All channels can be run off the same clock to provide a full 96 channel timing analysis.

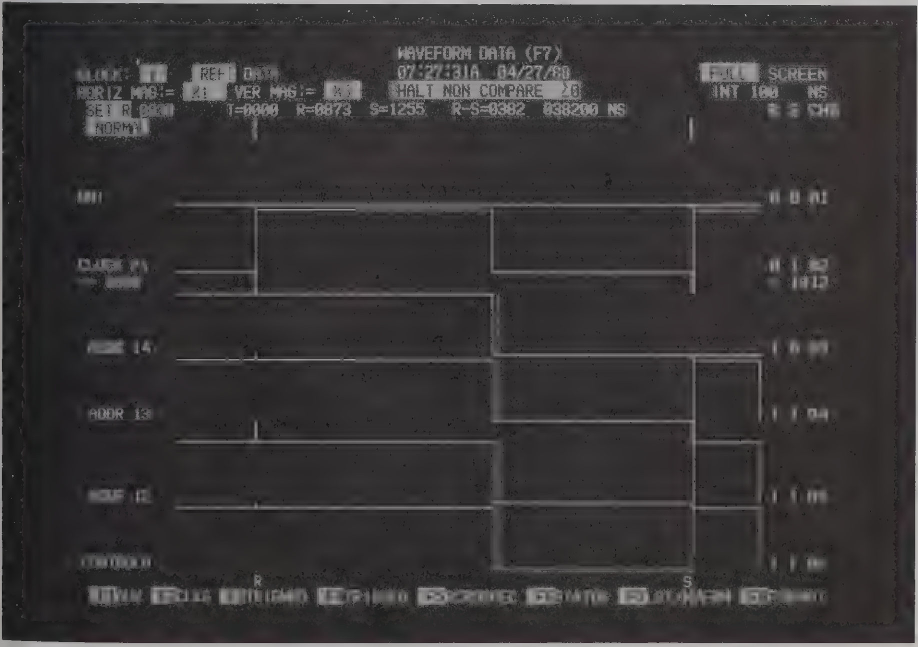
Powerful Triggering

Up to 12 trigger words and four trigger levels can be used for timing analysis. Time filters can be used to "qualify" the trigger condition; only triggering when the data is valid for more or less than a specified number of clocks. Events can also be counted creating a powerful timing trigger potential. State and timing trigger sequences can be integrated: for example, results from a state analysis can be used to qualify a timing trigger sequence; or you can trigger on combinations of trace results and timing data.

All these features combine to provide endless timing possibilities ranging from isolating trouble caused by too fast or too slow chip response times to debugging real time applications.



4. Record specifications screen shows the auto trace with no trigger enable. It's a free-running display that is continuously refreshed with new data. Each module's trigger point can be set to any amount of pre- or post-trigger data. And the trace qualification can be set, for each trigger level, to monitor an address range, I/O port, etc.



3. This timing diagram shows horizontal and vertical expansion, great for documentation.

Glitch Capture

The 5 ns glitch capture feature can be activated on all 96 channels without compromising either the maximum resolution (100 MHz) or reducing the memory available (2 kbits/channel).

In addition, high impedance (1MΩ/5/7 pF) probes ensure that short glitches are not suppressed by too much capacitive load and that in general, signals are not distorted.

Monitoring

The analyzer can set to capture a single event, when the acquisition is frozen on error detection, or continuously monitor signal activity. In this case, the AUTO-TRACE mode continuously updates the display on a set trigger condition or at regular 1 second intervals, allowing the user to monitor changes in the system without manually restarting the logic analyzer. This feature is invaluable for monitoring real-time applciations or debugging communications.

Comparison

The PM 3655 can also be set to capture data which is equal to, or not equal to, a set of reference data. A maximum allowed skew between the data may also be specified. The compare cycles are short, so the PM 3655 does not spend much time away from its main function of monitoring the system. Captured data can also be stored on disk, allowing you to monitor a system for intermittent faults and analyze the data at a later stage.

Combined State/Timing Analysis

Each of the 24 channel groups can be assigned its own clock; either the internal clock for timing analysis or one of four external clocks for state analysis. This allows groups of channels to monitor a microprocessor while others are performing timing analyzes on, for example, interrupt lines. As indicated earlier, state and timing trigger sequences are completely integrated allowing a mix of states and timing events to be checked.

Data Display Options

PM 3655 has sophisticated on-screen display features showing detailed information for fast problem identification, analysis, and solution.

A full timing diagram containing up to 24 channels can be displayed on the large 9 inch CRT. Signals can be displayed in any convenient sequence (as opposed to the usual pin number order) - for example all data lines together, clock signals next to data lines and so on, and a signal may be displayed in more that one position. In this way, you can directly see how the triggering relates to a signal or group of signals.

Furthermore, a comparison display allows you to observe the difference between a set of reference data and a set of captured data. Functions that allow the user to compensate for timing skew between the signals are built-in.

PM 3655

Waveforms

The displayed signals can be randomly selected from all 96 channels and displayed in any desired order. You can create up to four screens, allowing all 96 channels to be displayed. Each signal is identified by its pin number and an individual signal name to help you to analyze your results, and cursors can be used for timing measurements.

The horizontal zoom feature allows expansion of the time axis to measure more accurately timing differences between signals. A few critical signals can be selected for concentrated study by expanding the vertical axis with the vertical zoom. Both axes can be scrolled.

Data List

Data can also be shown as state lists. The state list layout can be set up as desired, using as many columns as necessary, mixing new data with reference data, showing bus data in hexadecimal and/or ASCII, and even showing individual lines in binary. This free format layout allows you to maximize the amount of useful information displayed and thus speed up problem analysis.

Disassembly List

Microprocessor specific disassemblers translate the data into machine code to ease program tracing and interpretation. The personality disassembler modules also arrange the data bus, address bus and status lines into a logical order on the display.

Split Screen

A split screen option allows you to display both state and timing signals simultaneously to observe both hardware signals and software flow. You can also combine waveforms and state lists, or disassembly lists, into one screen to check timing and state analysis at the same time. Both windows can be simultaneously scrolled, or scrolled independently so, for example, you can study program flow separately from the timing analysis.

Familiar Operation Plus a PC

ASCII Keyboard

A familiar ASCII keyboard makes it easy to enter signal labels. Function keys give you direct access to any of the screens making most information available with a single keystroke. "Fill-in-the-form" style menus and pre-set selections make entry of labels and trigger words easy and it is simple to toggle between all the options. When finished, you have a complete picture of the set-up with no hidden sub-menus to obscure details.

Mass Storage

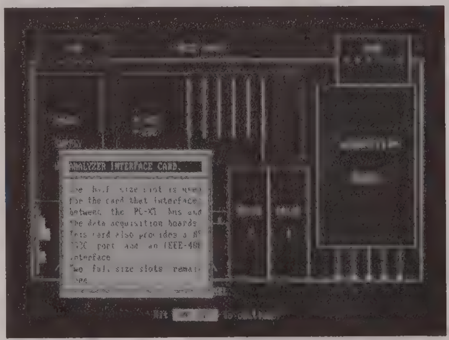
A 5¹/₄" double-sided double density floppy disk drive allows you to store captured data and frequently used setting, or to load reference data. Disks are MS-DOS compatible allowing files to be post- or even pre-processed. Series of measurements can be executed automatically by invoking special command functions similar to macros.

5. PM 3655 data running on a PC.

Additional PC Functionality

The PM 3655 can also be used as a personal computer. The 8 MHz 8088 main processor is PC/XT (turbo)-compatible with a separate bus architecture which ensures the logic analysis functions are not affected in any way. This allows the PM 3655 to run a range of MS-DOS software packages, so you can write reports on a word processing package, or integrate acquired data into spreadsheet packages. Your data can also be analyzed on a PC, as long as it has Hercules graphics.

Readily available software can also be used to convert the unit into an intelligent workstation, while four expansion slots allow you to upgrade or customize the logic analyzer with PC-plug in cards. These include internal modems, memory cards and LAN cards. A clock/calendar, Centronics printer port, RS-232C and IEEE-488 interfaces are standard on the PM 3655.



6. The tutorial offers a "manual on disk" for quick overview of the PM 3655 operation. You can run it on the logic analyzer itself or on a PC.

Specifications

Technical Specifications

Signal inputs

Data: 24 channel per block with a maximum of 4 blocks (96 channels)

Clocks: Internal; 20 Hz (50 ms)...100 MHz (10 ns) selectable in a 1-2-5 sequence. External; up to 4, each from DC to 100 MHz selectable positive or negative edge. Clocking; any clock can run any or all Data Blocks

Qualifiers: Up to 4; can be ANDed with any external clock. Each selectable for high or low state

Input Impedance: 1 MΩ/5-7 pF typical (8 pF max) at wire ends; all Data, Clock and Qualifier inputs

Min. Detectable Pulse: 12 ns in "SAMPLE MODE"; 5 ns in "GLITCH MODE".

Thresholds: Data-selectable in groups of 12 channels each. Clocks/Qualifiers-selectable in groups of 2 clocks and 2 qualifiers each. Range-selectable fixed TTL (+1.4 V), ECL (-1.3). Variable ±6.3 V in 100 mV increments.

Input Voltage: ±50 V continuous, ±100 V spikes with a max. duration of 50 µs.

Set-up Time: Data; must be present 2.5 ns (2 ns typically) before clock edge. Qualifers; must be present 5 ns (3 ns typically) before clock edge.

Hold Time: Data; must be held 2.5 ns (2 ns typically) after clock edge. Qualifiers; must be held 5 ns (3 ns typically) after clock edge.

Skew: Channel to channel 3 ns max.

Trigger

Type: "Edge"; this means that you must transition into the word selected for the instrument to recognize it. There is one exception; on level one of the trigger sequence, all "x's" (don't care) in the trigger word, will cause unit to automatically take a sweep of data and go into display

Width: Each trigger event may be specified as a 1 to 96 bit wide word (depending upon model) and terminate recording of all or each block of 24 channels

Specification: Trigger words can be specified in Hex or Binary format

Position: Trigger location may be specified anywhere in memory from 0 to 2038 and defaults to memory location 0047

Delay: Record window also may be delayed by clocks or events from 0 to 65534

Conditions: 4 levels with up to three words and a 255 clock time out per level, with multiple branch between levels. Full "IF-THEN-ELSE" control on each level. Area trace on each block, up to 96 channels wide. Any level can terminate any or all bolcks selected. When transferring from one level to the next the analyzer may not recognize trigger words for 40 ns worst case (30 ns typically).

Digital Filter: Trigger on words "greater" than 0-15 clocks long; trigger on words "less" than 2-15 clocks long

PM 3655

Recording

Glitch Mode: Every channel is capable of "glitch" catching down to 5 ns, selectable in blocks of 24 channels each

Memory Size:

1 card;	24 x 2048 bits deep
2 cards;	48 x 2048 bits deep
3 cards;	72 x 2048 bits deep
4 cards;	96 x 2048 bits deep

Conditions: Single trace-records data from start until trigger is found; completes recording, stops and automatically goes into display. Auto trace-continuously captures and displays data with or without a trigger word.

Compare/Non-Compare-R and S cursors used to select comparison zone. Comparison skew can be specified from 0-9 clocks for synchronous/asynchronous recording. Unit continues to run until condition is found; stops and goes into display.

In Timing, non-equal data between cursors shown as a one. In State non-equal data is displayed in reverse video.

Storage-back-up memory stores all recorded data and is selectable by block.

Set-ups - 2 set-ups are provided without accessing disc memory.

Display

Timing: Max. 24 channels per display

Horizontal Expansion; x1, x2, x5, x10

Vertical Expansion - 3, 6, 12, 24 channels

Any channel may be moved to any other location for display functions.

Cursors-Trigger-R and S. Difference between R and S shown in samples (external clock) or time (internal clock).

State: Data display selectable in ASCII, HEX, BINARY, OCTAL and DECIMAL by individual channel or block. Also, can be grouped in any combination up to 192 channels with eight separate groups available.

Disassemblers: 8-,16- and 32-bit CPUs shown in their respective mnemonics (disassemblers are optional). Devices currently supported are listed towards the end of this chapter.

Probe

Data: Maximum 8 data pods, each having 2 probes with 6 channels and two grounds leads each

Clock/Qualifier: Separate clock/qualifier pod with one probe for each function, each having 4 inputs

Disassembler (optional): Personality probes and cables are provided for matching 8-, 16- and 32-bit microprocessors

Circuit Interconnect: Pods are supplied with individual channel leads with 0,025 square sockets attached. Miniature clips are supplied for each lead. Cable lengths from probes to Logic Analyzer are 4' ±0.5' for clock/qualifier pod and 6' ±0.5' for data pods.

PC-XT Turbo Operating System

Keyboard: Full ASCII IBM PC "XT" keyboard with 10 soft keys

Computer: IBM PC-XT-Compatible capable of running MS-DOS. (8088, running at 8 MHz, can be set to run at 4.77 MHz)

Memory Size: 256 kbytes expandable to 640 kbytes (optional)

Disk Storage: Storage and down loading from system to floppy disk of setups, data and disassemblers

Disk: One 5¼" DS DD floppy drive (360 K) as standard. Space is provided for a second drive

Display: Amber CRT with self prompting menus. Reverse Video indicates programmable fields

Expansion: Ability to add up to two ½ size IBM "XT" Boards and two full size IBM "XT" Boards for additional features

Systems Interface

RS 232: Included as standard. Baud rates 9600, 4800, 2400, 1200, 600, 300, 150 and 100. Programmable separator. Control level: key simulation. Instrument settings and/or measurement data can be up/down loaded.

IEEE-488: Included as standard. Implements SH1, AH1, T6, L4, SR1, LR1, DC1and DT1.

Control level: Key simulation, full instrument programmability. Instrument settings and/or measurement data can be up/down loaded. Programmable separator (CRLF is default). Serial and parallel polling. Talker/listener.

Parallel Printer Output (Centronics): Included as standard

External Start: 50 ms pulse, TTL active low via rear panel 9 pin "D" connector

External Trigger In: TTL active low via rear panel 9 pin "D" connector. Pulse width 20 ns min. This signal may be part of the trigger sequence and is selectable in the first word location on each level.

Trigger Out: TTL active low after block 1 trigger recognition via rear panel 9 pin "D" connector. Output signal varies depending on clock frequency, and location of block 1 trigger in trigger sequence. If last location, trigger out is steady state until re-start.

General Specifications

Power: 90...132 V_{AC}, 50...60± 2 Hz; fuse 5 A Slo Blo 200...264 V_{AC}, 50...60 ± 2 Hz; fuse 2.5 A Slo Blo Maximum continuous power available 420 W (300 W typically)

Power Interruption: 10 ms (nominal power supply) No influence on setting and data storage.

Temperature:

Rated range of use: +5...+35°C (+41...95°F)

Operating range: 0...+40°C (32...104°F)

Storage and transport: -40...+70°C (-40...158°F)

Humidity:

Rated range of use: 20...80% non-condensing

Storage and transport: 5...95%

Altitude:

Rated range of use: 5000 m (16000 ft)

Storage and transport: 15000 m (50000 ft)

Shock and Vibration: Meets IEC 68, CSA 22, 151, standards.

Electrical Interference: Conducted VDE 0871 Class B, FCC class A; radiated VDE 0871 class B, FCC class A

Size: 535 mm x 215 mm x 585 mm (w x h x d); 21" x 8.5" x 23"

Weight:

48 ch configuration; 22.2 Kg (49 lbs)

96 ch configuration; 23.1 Kg (51 lbs)

Ordering Information

Models*

January 1989 prices

PM 3655/203 Logic analyzer, 24 channels	$4900
PM 3655/503 Logic analyzer, 48 channels	5900
PM 3655/703 Logic analyzer, 72 channels	7900
PM 3655/903 Logic analyzer, 96 channels	9900

**Note: Each model includes a complete set of logic pods and one clock and qualifier pod.*

Options**

PM 3655-01 RAM memory expansion to 640 kbytes; (no slots used)	350
PM 3655-02 Second Floppy Disk	450
PM 3655-03 20 Mbyte Hard Disk; (½ slot used)	850

***Options -02 and -03 are mutually exclusive*

Accessories

PF 8650 24 channel state/timing expansion module	2400
PF 8600 12 channel logic pod	350
PF 8601 Clock/qualifier pod	350
PF 8610 Personality adaptor and disassembler for 8085	1000
PF 8611 Personality adaptor and disassembler for 6800	1000
PF 8612 Personality adaptor and disassembler for 6809	1000
PF 8613 Personality adaptor and disassembler for 6502	1000
PF 8614 Personality adaptor and disassembler for Z80	1000
PF 8620 Personality adaptor and disassembler for 68000	2000
PF 8624 Personality adaptor and disassembler for 8068/8088	2000
PM 8819/30 50 miniclips (red)	75
PM 8819/90 30 Miniclips (black)	on req.

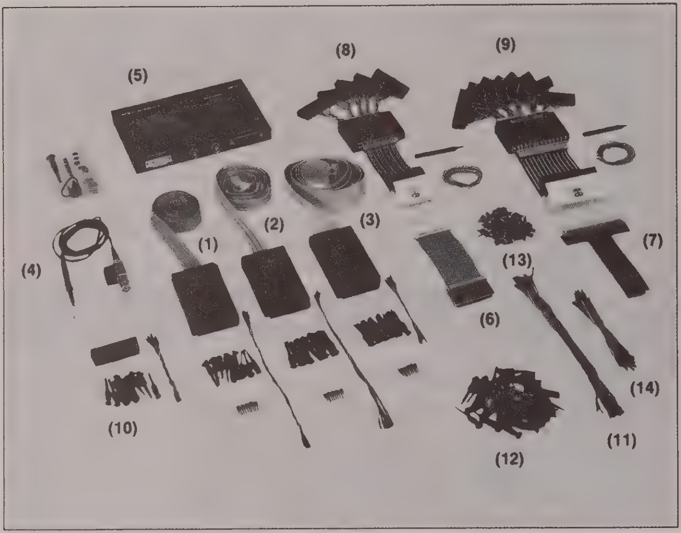
Service & Support

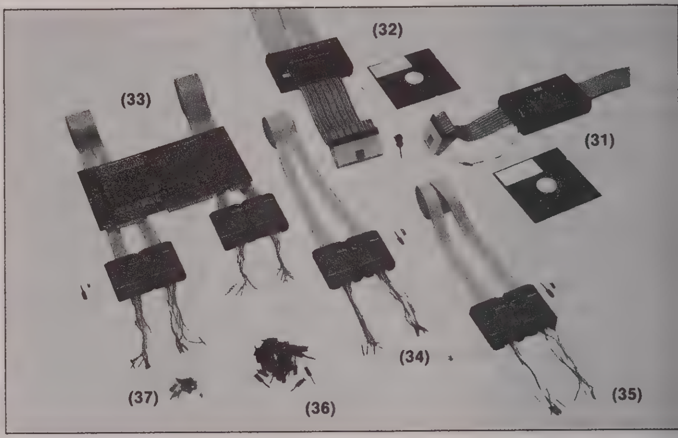
Warranty

One-year product warranty. (See page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see page 491.

Accessories





Accessories for PM 3565 & PM 3570

(3)	**PM 8826** 16-Ch Dual Timing Probe Pod	$1000
	PM 8827 132-Ch Single Probing Adapter	500
(5)	**PM 8811/001** Serial Data Pod	1195
	PM 8815/40 Flat Cable & 40-pin DIL Clip [1]	150
(6)	**PM 8815/45** Low Profile Connector to 40-pin DIL Connector	150
	PM 8815/48 Flat Cable & 48-pin DIL Clip	150
	PM 8815/64 Flat Cable & 64-pin DIL Clip	200
	PM 8815/65 Low Profile Connector	
(7)	**PM 8815/68** Pin Grid Adapter (68000/68010) 68 pin	75
	PM 8815/70 Pin Grid Adapter for 80286	750
	PM 8815/72 Pin Grid Adapter 68020/114 pin-Grid Front End of 68020	750
(8)	**PM 8817/40** Personality Adapter for 40-pin DIL	500
(9)	**PM 8817/64** Personality Adapter for 64-pin DIL	500
(8,9)	**PM 8817/xx** Range of Personality Adapters for particular microprocessors	500
(10)	**PM 8819/00** Extension Kit	75
(11)	**PM 8819/10** 54 Colored Leads (for PM 8820/8810)	75
(12)	**PM 8819/20** 35 Measuring Clips (black)	75
(13)	**PM 8819/30** 50 Mini Measuring Clips (red)	75
	PM 8819/40 54 Colored Leads (PM 8825 at 50 MHz, 15 cm)	75
	PM 8819/50 54 Colored Leads (PM 8825 at 300 MHz, 6 cm)	75

[1] part of accessories 8 and 9

Accessories for PM 3655

(34)	**PF 8600** 12 Ch Logic Pod	300
(35)	**PF 8601** Clock/Qualifier Pod	350
(31)	**PF 8610** Personality Adapter & Disassembler 8085	1000
	PF 8611 Personality Adapter & Disassembler 6800	1000
	PF 8612 Personality Adapter & Disassembler 6809	1000
	PF 8613 Personality Adapter & Disassembler Z80	1000
(32)	**PF 8620** Personality Adapter & Disassembler 68000	2000
(32)	**PF 8624** Personality Adapter & Disassembler 8086/88	2000
(33)	**PF 8650** 24 Ch State/Timing Expansion Module	2400
(37)	**PM 8819/30** 50 Mini Measuring Clips (Red)	75
(36)	**PM 8819/90** 30 Mini Measuring Clips (Black)	

Board Testers & Troubleshooters

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Page 172 9132A

Page 162 900

Most electronic equipment designed in recent years uses microprocessors. While this component makes it possible to design very sophisticated equipment at a low cost (such as personal computers), there are drawbacks in troubleshooting and repairing microprocessor-based circuit boards.

Astute manufacturers of electronic products know that the long-term success of their products depends on effective diagnostics in production testing, and fast, economical repair and service. That's why Fluke developed the innovative 9000 Series Micro-System Troubleshooter. It has proven to be a very cost-effective solution for hardware debugging, testing and servicing of microprocessor-based equipment, using any one of over 50 different types of microprocessors.

For easy and quick testing of board kernels (the heart of the board), Fluke is proud to introduce its new 90 Series. Easy to learn and use, the 90 Series features a very low price.

For higher levels of automated testing and troubleshooting in production lines or in service depots, Fluke offers the 9100A Digital Test System, today's most sophisticated, most capable emuative board tester.

Fluke's solutions go further, too; the 900 Dynamic Troubleshooter provides quick and accurate fault isolation to the component level; anywhere on the Unit Under Test. No detailed UUT knowledge or documentation is required. It can be used to complement any functional test or self test procedure to pinpoint the fault to a component.

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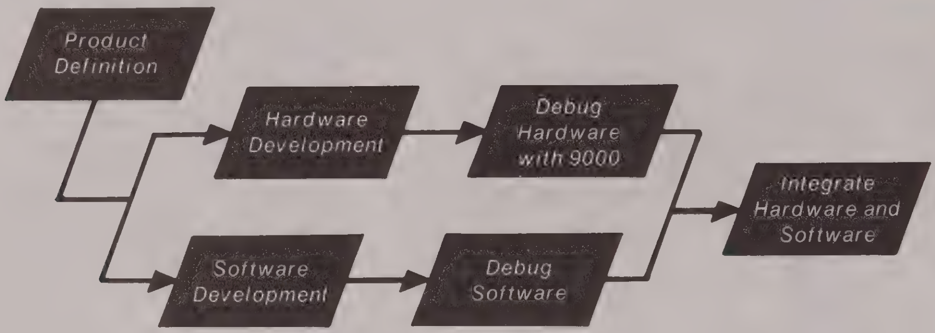
Interface Pods 178

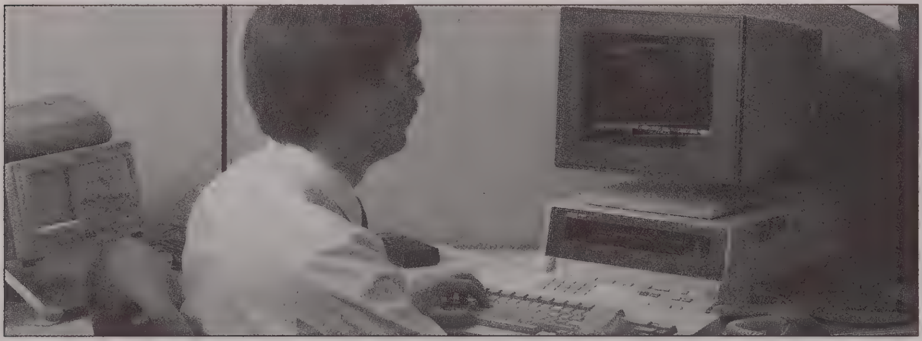
Options Compatibility 182

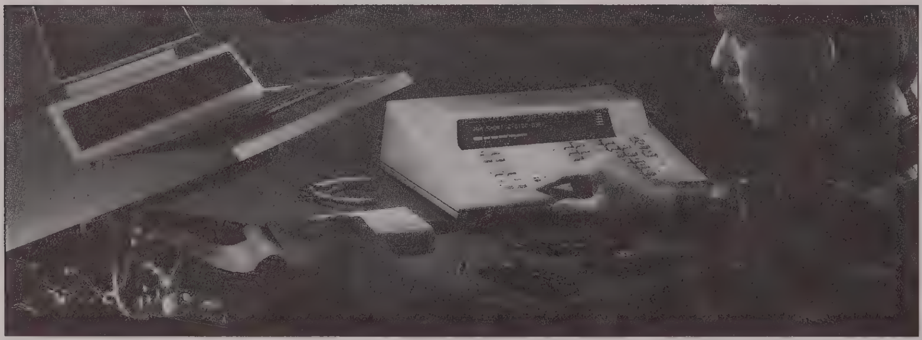
Product Development



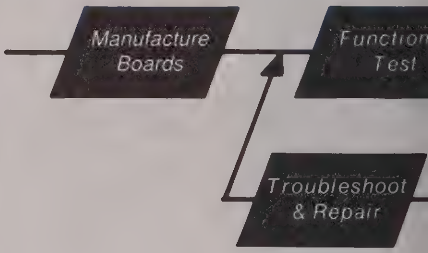
Prototype Debug

The **9010 Microsystem Troubleshooter** is the ideal tool for verifying hardware prototypes independent of system software. The low cost 9010A controls your board through the microprocessor kernel, allowing fast debugging without writing assembly code. Even with dead boards!





Manufacturing Board Test & Troubleshooting



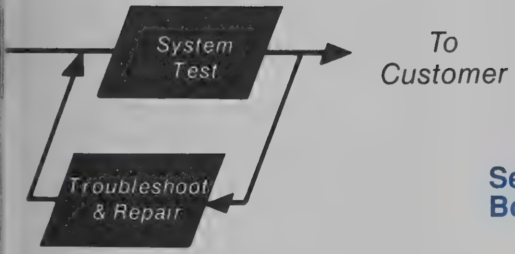
Functional Board Test

For medium and low volume board test, the **9100A Digital Test System** is the most productive, cost effective tester available. With its low capital cost, fast programming, and powerful test algorithms the 9100A offers test automation in an affordable, flexible package. Emulative Testing, at the heart of the 9100A, is the preferred technology for today's digital boards. The small size and low cost of the 9100A allows manufacturing test operations to be implemented in the most efficient manner, with dedicated product work cells, fast set-ups for small quantity production runs, and networking for data collection and process control. Software that is transportable to additional testers allows test capacity to grow incrementally as your test volume grows.

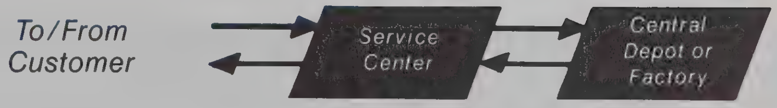
Fluke Board Testers

Highest Return For Your Test Investment. Fluke has been manufacturing electronic products for 40 years, and we are experts at testing and servicing our own high quality, high technology products. We offer this experience to you with innovative test equipment that is dramatically lower in price than traditional automated test equipment, while staying ahead of modern test requirements. Compare our board test products to any other, and you will find your highest R.O.I. comes from Fluke.

Plus, Common Test Philosophy for Product Development, Manufacturing, and Service. Fluke board testers break away from traditional techniques and limitations. For your products to compete, you require an integrated approach to design, manufacturing, and service. Fluke board testers offer test commonality between departments: tests designed in product development can be enhanced and used by production test, and then transferred to your service department. Advanced test software combined with lower cost hardware allows you to implement a corporate test strategy to meet your needs.



Service Board Test & Troubleshooting



Troubleshooting

Fast, accurate board troubleshooting is where the **9100A Digital Test System** really stands apart from any other board tester. Sophisticated Guided Fault Isolation (GFI) algorithms speed even inexperienced technicians to faulty nodes. Faults that would take hours to locate using an oscilloscope or logic analyzer take just minutes with the 9100A. Advanced test development software lets you, the test engineer, concentrate on writing powerful test programs quickly.

For a non-programmed solution, the **9010A Microsystem Troubleshooter** offers the same powerful Emulative Test techniques as the 9100A in a keystroke controlled package. The 9010A is a tool for the experienced technician, who can combine his knowledge of the Unit Under Test with the direct control of the 9010A.

The **90 Series** is a unique instrument for service technicians and design engineers with full-featured fault-finding capabilities. It is specifically designed for use in service departments for benchtop component-level testing and verification; and is also suited for engineering prototype testing, field monitoring applications and technician training.

Emulative testers may be complemented with the 900 Dynamic Troubleshooter which offers quick and accurate fault isolation to the component level. It tests a digital IC on the Unit Under Test (UUT) by comparing its performance to that of a known-good reference device and automatically analyzes the performance of the device under test as it operates in the circuit. It captures timing, intermittent, as well as static faults. It can test standard digital components from SSI to VLSI, (D)RAM and ROM, as well as custom parts like PALs, ASICs and gate arrays up to 28 pins.

When a stimulus is available for the unit under test, the 900 Dynamic Troubleshooter can troubleshoot non-microprocessor-based UUTs as well.

Centralized Repair

When repair is centralized , the **9100A Digital Test System** offers the same advantages to service as to manufacturing: cost effective automated test and troubleshooting for medium volume, large variety board test operations. If large board float inventories are a problem, consider using 9105As at your service centers as functional, Go/No-Go testers. The good boards swapped out of your customer's equipment can be identified and returned to use, while the bad boards are sent to your central site for repair.

Decentralized Repair

For fast customer response and minimal spare board inventory, board repair needs to be close to your customer site. The **9010A Microsystem Troubleshooter, the 900** and the **90 Series** offer the test and troubleshooting capabilities you need at prices you can afford to equip each service center. For an automated solution, programs written on the **9100A Digital Test System** can be implemented on the lower cost **9105A Digital Test Station.** Test software written at the factory or central service headquarters is distributed to the field on the execute only 9105A, offering the control and efficiency of centralized test programming with the low board float of decentralized repair.

900

NEW

900

900 Dynamic Troubleshooter

- Tests IC at speed while in circuit
- Supports standard and custom devices
- No test programs required
- Detects intermittent timing faults
- Softkey menu for easy operation

The Automated Troubleshooter for Dynamic Testing of ICs, at Speed, While Still in Circuit

The 900 Dynamic Troubleshooter is Fluke's newest addition to the board test product line. It's a powerful diagnostic tool for service and repair of digital circuits. The 900 provides you with a simple but effective means of testing ICs operating at speed, while still in circuit. Unlike other in-circuit testers, the 900 does not force any artificial signals into the UUT, nor does it try to backdrive devices or guard points. Yet with the 900, you can quickly isolate faults down to the individual component. No more "shotgun" attempts to repair a board! And because the 900 uses a proprietary comparison testing technique, you can pinpoint faults with little or no programming, and with minimal knowledge of the board under test or the individual components.

The Fluke 900 tests standard digital components, from SSI to VLSI, including (D)RAM and ROM, as well as custom parts such as PALs, ASICs, and gate arrays up to 28 pins. Components can be tested both IN & OUT of circuit. But no special software, device descriptions or fixturing is required.

The 900 is not a universal solution, but rather a powerful tool that helps a technician isolate faults rapidly and accurately. A technician can begin using the 900 with very little training. And the 900 can be used as a stand-alone tool, or as a complement to testing with hot mock-ups or emulative testers, such as the Fluke 90, 9010 and 9100 family of digital testers. One of these emulative testers can be used to quickly test the kernel of the UUT, and localize any fault to a subsection of the UUT. The 900 can then be used to isolate faults down to the defective component. A 9010A or 9100A can also be used to stimulate a board that is otherwise dead, so the 900 can then test ICs on the board while active.

A complete 900 tester includes:

- The main unit with graphic display, operator keypad, RS-232 interface port, and ZIF socket for a reference component;
- An interface buffer with high-speed signal conditioning to capture measurements from your board under test. No special pods or adaptors are required.
- A starter assortment of clips to attach to various sizes of ICs, from 14 to 28 pins; J-lead SO version SMDs are also available.
- Nonvolatile memory cartridges for storing predefined board test sequences, plus patch leads and antistatic reference device tray.

The Power to Solve Even the Toughest Problems

With its combination of unique features, the Fluke 900 excels at diagnosing faults in a wide variety of applications. Among these are:

Real-Time Component Tests While In-Circuit

The 900 tests the Device Under Test (DUT) as it operates in-circuit, in real time, at data rates of up to 20 MHz. The 900 does not backdrive the DUT or guard points, nor force any artifical signals into the UUT. Rather, it unobtrusively monitors the DUT while operating, and compares the DUT's behavior with that of a known good part. The 900 will detect a failure if the response of the DUT differs by greater than 20 nsec from the response of the reference part. The timing tolerance can be adjusted with 10 nsec resolution to compensate for normal circuit loading conditions.

Tests Without Software Programs

The 900 tests digital ICs by comparing a known good reference chip to the DUT on the board. Just plug in your reference chip and clip onto the DUT. Since the reference chip serves as a model for the test, the user does not have to write any device timing descriptions or test software. The user can optionally specify a test sequence which lists the preferred order in which ICs are to be tested on a board; any adjustments to the setup parameters for each IC can be added. These test sequences can be stored on nonvolatile memory cartridges.

Detects Intermittent & Thermal Faults

The 900 continuously monitors every pin on the DUT, asynchronously, without clocking or sampling. This insures that intermittent or one-shot faults will be captured, with the same 10 nsec resolution as timing and static faults. The user can choose the duration of a test, so the 900 can be set to capture elusive intermittent faults.

Tests Even When You Have No Documentation

Incomplete or even incorrect documentation is a common problem with today's constantly changing designs. But the 900 can still be applied when limited device descriptions or no detailed schematics are available: known good parts essentially define the tests for components in the UUT. And since reference parts define the test for each chip on the UUT, the 900 can readily test a private-labelled, or proprietary custom IC – even when extensive documentation is unavailable. Of course, a known good board will help determine if any timing resolution adjustments are necessary for individual ICs on the UUT.

Isolates Faults in "Untestable" Circuits

Some testers have difficulty with components in "untestable" circuits, such as ICs wired into loops, or ICs which have internal memory. The 900 readily handles many such common testing problems:

Hardwired Inputs or Outputs: The 900 tests ICs when input leads are tied together, or strapped to supply. Both the reference device and the DUT will see the same data on their respective input pins, and the 900 accepts that as a normal circuit condition.

Components with Internal Memory (e.g. ICs with latches or counters). The 900 has built-in synchronization routines to put the reference device and the DUT in the same state when the test begins, even if the DUT's internal memory cannot be initialized because control pins are strapped in an inactive state.

Feedback Loops & Apparent Multiple Faults. Fault isolation in feedback loops can be difficult, since the fault seems to be everywhere at the same time. The 900 measures and displays the amount of time elapsed until the fault occurs, with 40 nsec accuracy. By identifying the earliest device to fail, the 900 can be used to isolate the defective IC in a loop.

Bus Devices. The 900 readily tests bus devices, since the 29-channel Gate function can be used to insure that actual testing is performed only when the DUT is active on the bus.

Short Circuits and Open Circuits. The 900 monitors every pin on the DUT for any activity or for activity at a specifiable frequency, and flags any pin when there is no activity – whether due to a shorted node or an open lead. A conventional shorts finder could be used to pinpoint the actual physical location of a short.

Memory Testing. The 900 treats memory devices, even DRAM, like any other logic device. Since all data and timing signals are replicated, the 900 will perform full tests on memory chips. (RAM chips must have memory locations written before being read, so the DUT and reference device will have the same data.)

Still More Capabilities

The Fluke 900 has several other features which make it an even more effective troubleshooting tool:

Built-in Frequency Counter. The 900 can measure signal activity on all of the DUT pins, plus one additional external node – at up to 25 MHz, accurate to within 0.5%.

User-definable Trigger. A two-word trigger function can be defined from a combination of 28 signals on the DUT's leads plus an external node, to start a test (similar to a conventional logic analyzer). Trigger event detection is a powerful diagnostic tool: it helps isolate the occurrence and then location of a fault.

User-definable Gate. Alternatively, a one-word gate function can also be defined from a combination of the DUT's pins plus an external node. This controls when comparisons are actually made between the DUT and the RD, such as in testing a bus driver.

User-definable Test Cycle. The 900 can be set to issue an automatic RESET signal to the UUT at the start of the test for each device. The user can also set the duration and timing of the reset pulse, relative to the comparison test, as well as the length of the overall test.

Nonvolatile RAM Cartridges. Memory modules, 32K bytes, can be used to hold test results, or predefined test sequences.

RS-232C Interface. This supports both software and hardware handshake protocols, and is programmable with data rates up to 19,200 baud. An optional IEEE-488 interface is also available.

Automatic Logging of Test Results. The 900 can be set to automatically save detailed test results on a memory pack, or to a device connected to one of the remote interfaces.

Friendly Operator Interface. The 900 has a softkey based menu-driven interface which supports operation of the unit, plus complete creation and editing of test sequences.

Complete Product Training and Support. So that you can get the maximum use out of your 900 right away, Fluke offers a hands-on in depth training course on troubleshooting with the 900. You are entitled to a free certificate for this two day course, with the purchase of a 900. Your account manager has the details. See page 476 for more information on Fluke's training courses.

Theory of Operation

The Fluke 900 operates on the principle of Dynamic Hardware Reference Comparison. This means that the *real-time* operation of the DUT is compared to that of a known good Reference Device (RD). Comparisons are made while the DUT is operating at speed, for data rates up to 20 MHz (not clock rates).

The 900 continuously monitors the DUT and RD to determine which pins are inputs and which are outputs at any given moment; tri-state and bi-directional pins are handled automatically. The 900 is thus able to apply to the input pins of the RD the same signals as are on the input leads of the DUT while still operating in circuit. Simultaneously, the 900 checks for any differences in the outputs of the two chips, and flags these as errors; discrepancies down to 10 nsec are detected.

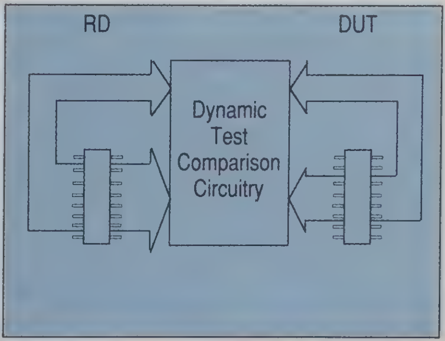
Some activity on the UUT is necessary in order for the 900 to test the performance of individual ICs. Since the 900 measures and displays the test time elapsed up to when a fault occurs, it can test even boards which crash after just a few machine cycles. In some cases, an emulative tester, such as the Fluke 9010 or 9100, or else a hot mock-up, can be used to stimulate activity on the UUT.

While the 900 isolates faulty components in circuit, it does not backdrive devices or guard points like other in-circuit testers. Instead, it monitors the signals coming into the DUT's pins, and replicates these on the RD; outputs are compared in real time, as the chips operate at normal clock speed.

Of course a RD will not experience the exact same loading as the DUT does in circuit. This can result is slight differences in the response times of the RD and the DUT. The 900 compensates for this by using a specifiable value for the acceptable difference (or fault window) in response times for the two chips – adjustable from 10 nsec on up, in 10 nsec steps.

Logic threshold levels can also be specified, at any level between 0 and 5 volts, with a resolution of 100 mV.

The fault window and logic threshold voltage levels together define a Performance Envelope against which the DUT is compared to the RD.



To determine the Performance Envelope for various DUTs, a known good board should first be examined. Any ICs on this good board for which the acceptable fault window and/or logic voltage levels differ from the regular setting should be noted. These test adjustments can be stored in nonvolatile RAM cartridges, as part of a test sequence for the UUT.

900

Test sequences can be written for any UUT. Rather than complicated software programs, these test sequences are simply a list of the order in which to test the devices on the UUT, along with any adjustments to the Performance Envelope, and any user-specified trigger or gate words. Comments or instructions to the operator can be included here, for each step in the test sequence. The operator can work through the test sequence in the specified order, simply by pressing the NEXT key for each step, or can jump around within the sequence to a particular component, to take advantage of his experience.

Specifications

Power: 115/230V ac, 47 to 63 Hz, 100W
Storage Temperature: -40°C to +70°C
Operating Temperature: 0°C to +50°C
Size:
  Main Unit: 12 x 15 x 3.5 in (30.5 x 38.1 x 8.9 cm)
  Interface Buffer: 8 x 8 x 0.75 in (20.3 x 20.3 x 1.9 cm)
Cable Length: 48 in (122 cm)
Weight: 12 lb (5.44 kg)

Electronic Parameters

Devices Supported: Digital components up to 28 pins, SSI to VLSI capable of driving one LS load. N, S, F, LS, AS, ALS, HC, HCT, ACT, FACT, Open Collector TTL, 4000, I4000 CMOS optional.
Custom Components: PAL, HAL, PLA, FPLA, and Gate Arrays.
Memory: Static and dynamc RAM, ROM, PROM, EPROM, FIFO
Fault Discrepancy Resolution: 20 to 200 nsec (adjustable in 10 nsec increments)
Device Initialization and Synchronization: Times programmable from 10 to 9990 msec; test time from 1 msec to 9990, or continuous
Frequency Counter Measurement: To 25 MHz, <.5% 20% min. duty cycle for frequencies >20 MHz
DUT: Tested at data rate of up to 20 MHz
Minimum Pulse Width: 20 nsec
Minimum Slew Rate: 10V/µsec
Pin Loading on UUT: 10 KΩ @ 30 pf
Inputs Protected: To ±25V
Device Logic Levels: 0 to 5V, in 100 mV steps
Trigger Circuit: User-specifiable, two word of 28 pins on the DUT plus one external node; test cycle begins when trigger condition(s) met
Gate Circuit: User-specifiable, one word of 28 pins on the DUT plus one external node. Comparison test is performed ony while gate condition is True.
Trigger or Gate: Can be used at any on time
Reset Circuit: Programmable to be positive or negative; is tri-stated when not active. Position of Reset pulse is programmable relative to test cycle, from 0 to 9990 msec before/after start of comparison test, with 100 msec increments. Pulse duration is 100 msec
Can use either internal power or from the UUT:
Internal: Supplied from 5 V source;sink/source 50 mA @ .8/4.2V
External: Supplied from UUT (2 to 15V); sink/source 50 mA @ 0.8/V_{ext} -0.8V

Ordering Information

Model

January 1989 prices

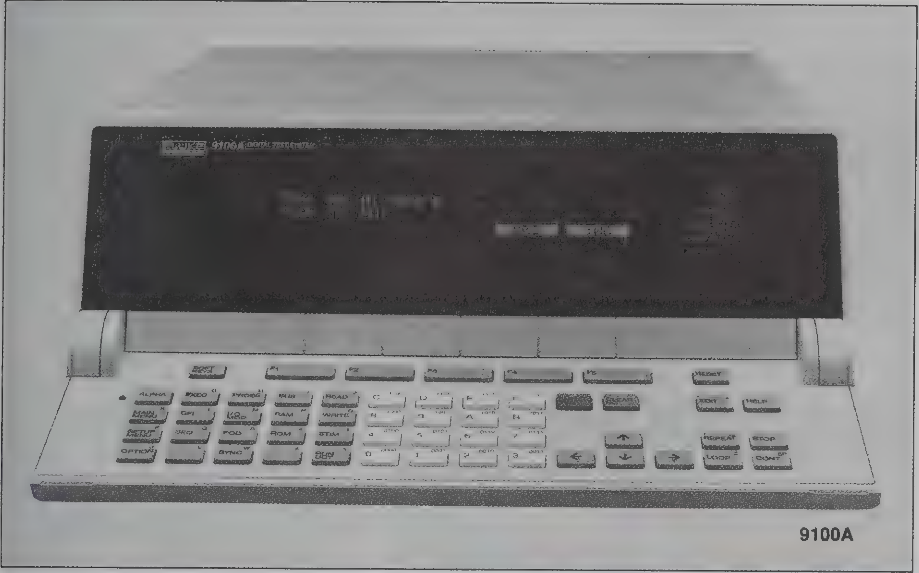
900 Dynamic Troubleshooter $7990
  Includes: 900 Main Unit
  Interface Buffer
  Three Test Clips:
  Y900-16D 16-pin, 0.3" Test Clip
  Y900-24D 24-pin, 0.3" Test Clip
  Y900-28D 28-pin, 0.6" Test Clip
  Y900-001 Data Cartridge
  Y900-005 Set of Patch Cords
  Y900-003 RD Tray & Cartridge Holder
  User's Manual
  Power Cord
  See your Fluke Representative for details on training

Options & Accessories

Y900-001	Data Cartridge	120
Y900-002	Data Cartridges, set of 3	360
Y900-003	RD Tray & Cartridge Holder	30
Y900-004	RD Tray & Cartridge Holder, 3	30
Y900-005	Patch Cords & Clips, set of 5	100
Y900-006	Carrying/Shipping Case	400
Y900-8D	Test Clip, 8 Pin Dip, 0.3"	100
Y900-14D	Test Clip, 14 Pin Dip, 0.3"	100
Y900-16D	Test Clip, 16 Pin Dip, 0.3"	100
Y900-18D	Test Clip, 18 Pin Dip, 0.3"	100
Y900-20D	Test Clip, 20 Pin Dip, 0.3"	120
Y900-24D	Test Clip, 24 Pin Dip, 0.3"	120
Y900-24DW	Test Clip, 28 Pin Dip, 0.3"	120
Y900-8S	Test Clip, 8 Pin S.O.I.C., 0.1"	140
Y900-14S	Test Clip, 14 Pin S.O.I.C., 0.1"	140
Y900-16S	Test Clip, 16 Pin S.O.I.C., 0.1"	140
Y900-16SW	Test Clip, 16 Pin S.O.I.C., 0.2"	140
Y900-18S	Test Clip, 18 Pin S.O.I.C., 0.2"	140
Y900-20S	Test Clip, 20 Pin S.O.I.C., 0.1"	160
Y900-24S	Test Clip, 24 Pin S.O.I.C., 0.1"	160
Y900-28S	Test Clip, 28 Pin S.O.I.C., 0.1"	160

9100 Series

RS-232



9100A

9100 Series Digital Test System

- Emulative Board Test: Test microprocessor-based digital circuitry from the microprocessor kernel outward
- Automated Functional (GO/NO GO) Tests and Guided Fault Isolation (GFI) Test
- Integrated program development environment
- Automatic functional tests of µP kernel
- Automatic generation of GFI decision tree
- Support for over 50 microprocessors
- I/O module and single point probe to "close the loop" in measurement or stimulus
- FREE Applications and Programming Courses with purchase!

The 9100 Series is the top of the line in Fluke's family of digital testers and troubleshooters. It is designed for fast, cost-effective automation of your test and troubleshooting procedures for microprocessor-based digital circuit boards.

Included in the 9100 Series are two testers: the 9100A Digital Test System, which can be used both for developing test software and as a stand-alone test station, and the 9105A Digital Test Station, an execute-only tester that can be used to execute programs developed on the 9100A.

The 9100A offers fast and easy development of functional test and troubleshooting programs which stay ahead of the increasing complexity of digital boards. Test program design is highly automated, guiding the test or service engineer through the development process. Combined with new state-of-the-art test hardware, complete digital board test and repair solutions can be implemented in record time.

The 9105A Digital Test Station turns a powerful test solution into an economical one. At very low cost, the 9105A delivers powerful automated tests, developed on the 9100A, to the factory floor or service center. An easy to use interface allows any operator to quickly test and troubleshoot. Guided Fault Isolation (GFI) programs isolate faults to the node level, so both functional testing and troubleshooting can truly be automated. The 9100A and 9105A combine to offer unmatched power, flexibility, and economy to factory board test and service center repair.

Both testers interface with the unit under test (UUT) through the following hardware components:

- A microprocessor or memory interface pod that emulates the microprocessor actions on the UUT.
- A single-point probe to measure UUT responses at any node within or beyond the microprocessor kernel; the probe can also provide stimulus at any node.
- I/O modules which provide stimulus and gather response at up to 160 nodes simultaneously.

Test Techniques For Every Part of the Board

The 9100 Series can detect and isolate faulty components on all types of microprocessor-based circuit boards. Types of tests include built-in functional testing of the microprocessor BUS, RAM, and ROM. The 9100 Series will also isolate faults in both synchronous and asynchronous circuitry and, through its interface pods, can emulate a broad range of microprocessor chips. Together, these capabilities let you test your products more thoroughly and with a higher degree of confidence than ever before – for prototype debug, during production, and in the field.

Emulative Board Testing

At the heart of Fluke's approach is a technique known as emulative board testing – so called because it involves either microprocessor or memory emulation. The function of any emulation pod is to provide an interface between the circuit board under test and the test mainframe, adapting the general architecture of the mainframe to that of the specific microprocessor on the circuit board under test.

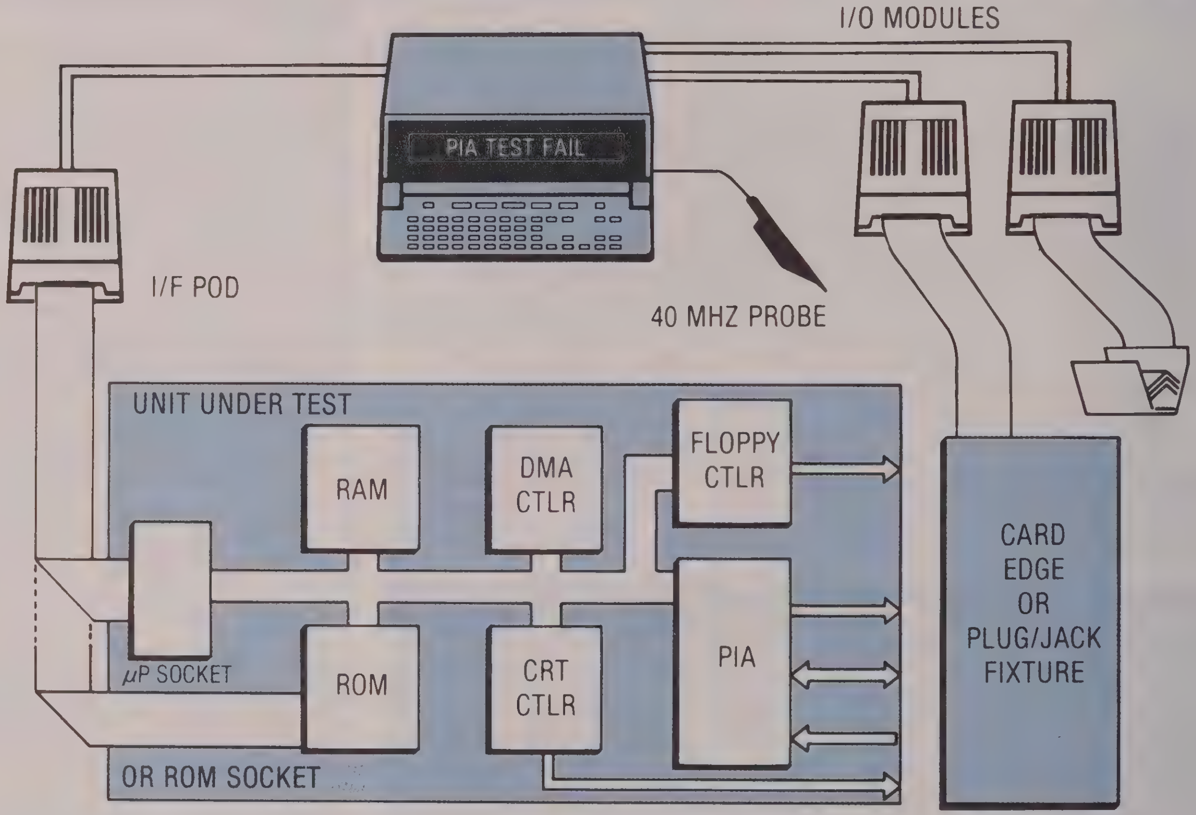
These emulative board test techniques are preferred by board manufacturers the world over because they are the only techniques that test a board from the "inside out." By troubleshooting the kernel circuitry first, you have a solid base for testing the remainder of your board. Consequently, you locate more faults, more quickly, than with any other approach.

Pods are available to support more than 50 microprocessor chips, including the 80386 and 68020. All existing Fluke interface pods can be used with the 9100 Series.

Microprocessor interface pods. To emulate the board's microprocessor, you select the microprocessor interface pod that corresponds to the microprocessor on the board. In addition to containing its own microprocessor, each pod has its own RAM, ROM, and I/O, making it a complete kernel. The pod replaces the board's microprocessor, allowing the pod to control all bus-related devices on the board. Plugging in the pod also causes the clock circuit of the board under test to be channeled to the pod's microprocessor, so that tests can be performed with the board running at its normal speed. For a complete listing of available microprocessor interface pods, please refer to page 178.

Memory interface pod. The 9132A Memory Interface Pod is the newest addition to Fluke's family of interface pods. It features the capability to be reconfigured for additional microprocessors by simply replacing a plug-in personality module. The 9132A provides the same test capabilities of previous pods, including READS, WRITES, RAM test, etc., and uses the same user commands so operation is identical. The difference is in how UUT connections are made, with interfacing through the UUT ROM and via a sync module. For more information on Fluke's memory interface pod, please refer to page 172.

9100 Series



COMPLETE DIGITAL FAULT COVERAGE

Built-in BUS, RAM, and ROM tests. Using the pods, you can quickly execute the 9100 Series' built-in BUS, RAM, and ROM test routines. Because these circuits operate the same way on all microprocessor-based boards, you can run these tests as soon as you plug in the pod, without writing any code at all. At the conclusion of each test, the system reports its findings to the operator via specific fault messages.

Functional Testing Beyond the Kernel

I/O modules for rapid fault isolation. One of the innovations offered with the 9100 Series is the new type of circuit interface device for node-oriented troubleshooting: the I/O module. This module, which lets you test all pins on a chip at once, provides a quick means of detecting and isolating faults for signals up to 10 MHz. It works with both synchronous and asynchronous circuitry, on or off the bus. And, because you can use up to four I/O modules at a time, you can test as many as 160 pins simultaneously.

Modules may be clipped directly over the chip via DIP or SIP clips, available in configurations ranging from 14 to 40 pins. Or you can use the 9100 Series 20-line flying lead module to develop your own custom connections, connecting the tester to the board edge or a customized test fixture.

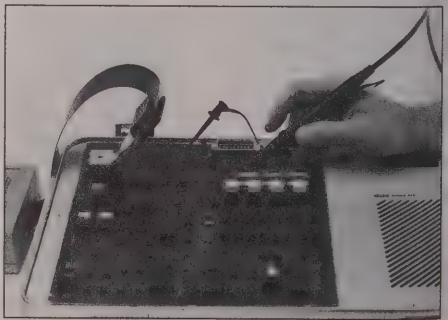
The I/O module lets you use a variety of test techniques. You can use it to drive a node high or low or to stimulate it with a string of data patterns. It can also gather a wide range of response data, including taking a node's signature, sensing its logic level, and measuring activity on a node through frequency measurements or event counting. Built-in clock connectors let you synchronize the module to an external clock when troubleshooting asynchronous circuitry.

Card Edge Fixture Kit

The Card Edge Fixturing System profices a fast, reliable way to interface the Fluke 9100A and 9105A Digital Test Systems to any digital circuit board with a card edge connector. The Card Edge Fixture is ideal for accessing signals at the card edge and for testing boards with an external bus.

Vector Output I/O Module for Card Edge Stimulus

New for 1989, this I/O Module offers high speed st under control of the 9100A. It can provide real-time signals to the UUT card edge, allowing limited bus emulation with handshake input, pattern looping, and dynamic tri-state control to each bit. Modules are 40 bits wide, and up to four modules can be used at one time.



Single-point probe for high-frequency signals. You can use the single-point probe instead of the I/O module for higher-frequency signals, up to 40 MHz. You can also use it for parts of the board that cannot be accessed with an I/O module. Like the I/O module, the single-point probe can be used to drive a node high or low, to stimulate a node, and to gather various types of response data. It can take signatures, sense logic levels, and count events or frequencies. An external clock module provides leads for testing asynchronous circuitry.

Ways to Use the 9100A

Get as Much – or as Little – Automation as You Want

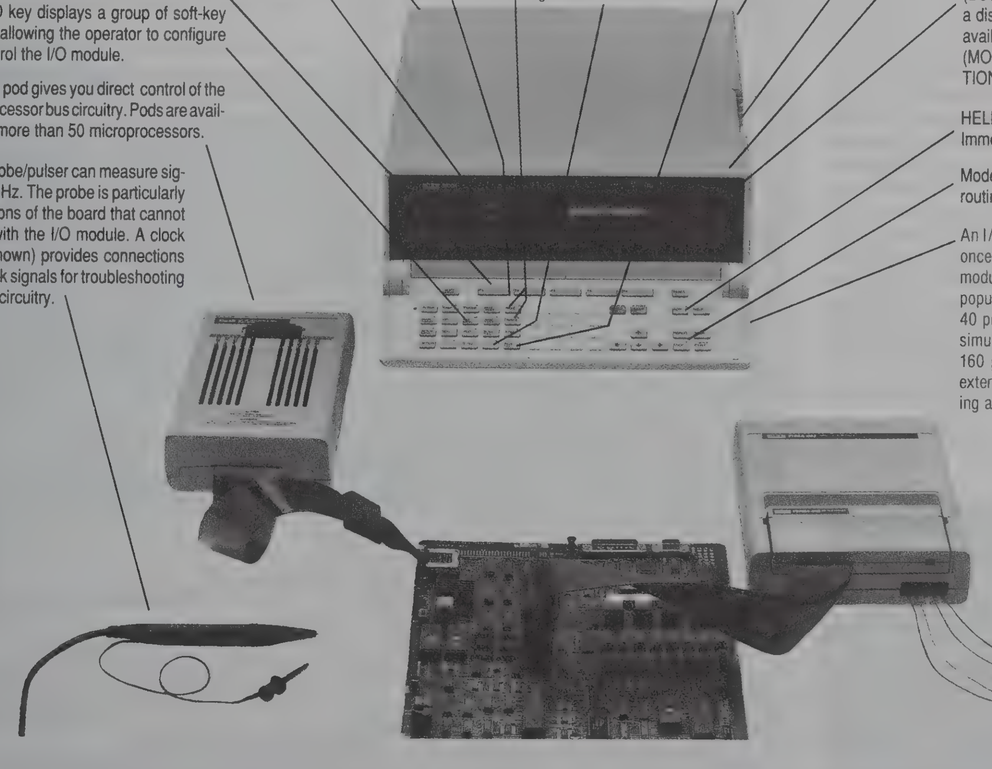
With the 9100 Series, you choose the degree of automation you want: Immediate Mode, for manual operation; Guided Fault Isolation, for automation of the troubleshooting process; or Unguided Fault Isolation, for semi-automated troubleshooting. If you do decide to automate, you'll find that many of the 9100 Series' special features – including the programming workstation, high-level programming language, and built-in Guided Fault Isolation decision tree – make the process easier and faster than you ever thought possible.

Manual Operation Lets You Start Testing Immediately

Immediate Mode lets you begin using your 9100 Series tester the first day you get it, without having to write any program code at all. With the pod connected, you can complete the built-in kernel tests. Then you can go on troubleshooting, using your knowledge of the unit under test to guide you.

Automatic Operation Guides the Operator From Start to Finish

For fully automated operation, the 9100 Series provides Guided Fault Isolation capability. In this mode, the operator enters no data and makes no



Up to 4Mb total memory lets you develop large applications.

Powerful Motorola 68000 microprocessor allows fast execution of all tests.

Clear, easy-to-read three-line vacuum fluorescent display has a line length of 42 characters.

Five soft-keys are user-programmable in Guided Fault Isolation and Unguided Fault Isolation Modes. In Immediate Mode, the default values of these keys are used. Soft-key labels are displayed on the bottom line of the three-line display.

I/O MOD key displays a group of soft-key options, allowing the operator to configure and control the I/O module.

Interface pod gives you direct control of the microprocessor bus circuitry. Pods are available for more than 50 microprocessors.

Single-point probe/pulser can measure signals up to 40 MHz. The probe is particularly useful for portions of the board that cannot be accessed with the I/O module. A clock module (not shown) provides connections to external clock signals for troubleshooting asynchronous circuitry.

16 hexadecimal keys as well as alphanumeric keys allow programmers to easily respond to system prompts.

Read and Write keys allow the retrieval and placement of data at specified addresses on the UUT.

RAM, ROM and BUS keys allow speedy execution of pre-programmed kernel tests.

STIM key provides access to built-in stimulus routines: Data Toggle, Control Toggle, Address Toggle, Rotate and Ramp.

Two RS-232-C serial ports allow data transfer to and from the tester. One is isolated, for use with the UUT. The non-isolated port is typically used for connection to a computer or printer.

Micro floppy disk drive allows the transfer of programs and data between 9100s and 9105s.

20-Mb hard disk allows convenient storage of multiple programs. (Standard on 9100A only).

Annunciators display mainframe status (BUSY, STOPPED, RUN UUT) show when a disk is being accessed, and indicate the availability of more display information (MORE SOFT KEYS, MORE INFORMATION).

HELP key provides context-oriented help in Immediate Mode.

Mode control keys control application of test routines: Loop, Repeat, Stop, Continue.

An I/O module lets you test up to 40 pins at once. Handy DIP clips, used to attach the module to the chip, are available in all popular pin configurations, from 14 through 40 pins. Up to four modules may be used simultaneously, allowing you to test up to 160 pins at a time. I/O modules contain external clock connections for troubleshooting asynchronous circuitry.

decisions. All necessary data – stimulus routines, reference lists, parts lists, known-good responses, and interconnectivity information – are contained in the program. The system tells the operator what nodes to probe and interprets all response data.

A key advantage of the system's Guided Fault Isolation capability is that all operators can benefit from the knowledge of your most experienced test engineers. Once your test engineers write the Guided Fault Isolation procedures, lower-level operators can execute them, saving you considerable labor costs.

Semi-automatic operation lets you choose the troubleshooting sequence

For semi-automatic troubleshooting, you can use the 9100 Series to perform Unguided Fault Isolation. This mode is like Guided Fault Isolation, except that the operator decides which node to probe. However, much of the manual activity is removed from the process, so you can troubleshoot more rapidly.

Once a node is selected, the appropriate stimulus routine is executed and the results of the stimulus are displayed. In this way, the operator guides the fault tracing procedure.

For experienced troubleshooters who prefer to follow their instincts rather than moving through a set troubleshooting sequence, Unguided Fault Isolation is the best technique.

The 9100A Programming Environment

(With Options -004, -005)

From its built-in back-tracing algorithm to its easy-to-use programming language, the 9100 Series lets you develop fully automated test and troubleshooting routines in a matter of days or weeks, as opposed to the months of development time required by many other systems.

Built-in GFI decision tree. The 9100A's specially designed back-tracing algorithm makes all the decisions about the troubleshooting sequence, allowing the programmer to enter the necessary information in simple data-base format. Information is stored in five kinds of files:

- Stimulus programs to test each node.
- Known-good responses to compare with UUT responses.
- A reference list relating the device number to the type of device.
- A parts library that explains the relationship of input pins to output pins.
- Interconnectivity data, indicating which devices and pins make up each node.

Special test language. The 9100A uses a programming language designed specifically for developing test and troubleshooting routines. Its command list incorporates all of the 9100 functions, program control constructs, and allowed variables, making it a well-rounded language for writing test programs.

Numerous features are designed into the program to make the programmer's job easier. Key among these are:

- Provision for default entries on most commands, simplifying the process of creating test routines.
- Built-in fault handlers that you can incorporate in your routines. (You can also choose to override these built-in fault handlers with custom-created ones).

You can write functional tests incorporating the microprocessor interface pod, I/O module, and probe. A debugger is provided with break point and single step capabilities to help you quickly locate any problems. You can also write administrative programs for example, to track board failures and the associated faulty components for future analysis.

Programming with the -004 is performed through an 80-column, 24-line CRT and a standard computer-style keyboard. The keyboard also includes nine soft keys with built-in functions to speed program development. The -005 includes the keyboard and a color video card to support customer-supplied color monitor.

The 9105A Test Program Executio

The 9105A is an execute only version of the 9100A. It performs the same immediate mode operations as the 9100A and it will execute al programs written on the 9100A but you can no write programs with the 9105A. It has 2.0 Mbyte of RAM memory space and two floppy disk drives rather than a hard disk drive.

Customer Support Services

Fluke's support programs are designed to mee the needs of a wide variety of users.

Customer Training Applications course. The 9100 Series offers you a choice of test techniques as well as a variety of circuit-interface devices. The best choice for a particular situation depends both on the type of circuitry involved and on your objective (functional test fault isolation, etc.) Fluke's product applications course shows you how to apply the 9100 Series to a wide range of circuits commonly found in microprocessor-based systems, so you can select the most appropriate test technique and interface device for each application.

Programming course. You will benefit from guidance in how to develop effective Guided Fault Isolation routines for different types of test and troubleshooting procedures. Fluke's programming course will help you get the most from the system's Guided Fault Isolation capabilities.

These courses are *free* to you when you purchase a 9100. Get the most out of the extensive capabilities of the 9100 with our in-depth, hands-on training courses.

System Integration. Fluke's contract consulting, programming and fixturing services offer still other options. You can contract with us for test software consulting help as you work on your own applications and programs, or you can have us simply develop programmed test and troubleshooting routines for you, customizing them to your particular products and procedures. Fluke's system Integration Group and Fluke Cooperative Services are available to help, from test fixturing to turnkey projects. Contact your local Fluke sales representative for a proposal.

Service

- **Worldwide network of technical centers.** Fluke's worldwide network of technical centers makes it easy for you to maintain and service your system, no matter where your operation is located.
- **Standard Warranty.** Your 9100 Series tester comes with a 90-day warranty, including both time and materials. Warranty service is available at any Fluke Technical Center, worldwide.
- **Extended Warranty Agreement.** All 9100A mainframe, options and accessories come with a 90 day warranty. A one year, renewable, Extended Warranty, covering all repairs with performance testing, including parts, labor and return surface freight costs.

This warranty will be discounted 10% if purchased with the instrument or if purchased prior to expiration of product warranty.

- **On-Site Service.** Even if you have an application where uptime is critical, Fluke can help. On-Site Service Agreements are available.

Software Support Agreement

A Software Support Agreement is a two year renewable agreement that provides for automatic software updates during the covered period. Software releases which enhance the speed or performance of system and/or programmer's system software operating on the 9100A and 9105A will be made available to Software Support subscribers at no additional cost. Manual revisions and updates are included.

In addition, Software Support subscribers have automatic membership in the 9100 Electronic Bulletin Board, an on-line users group. The Electronic Bulletin Board provides easy access to other 9100 users and experts at Fluke for the purpose of sharing information, TL/1 programs, papers, and more. Access to the Electronic Bulletin Board is available through a special toll-free 800 number, using any terminal, including a 9100A connected through a modem.

9100 Features

Mainframe: 20 Mbyte Hard Disk for program development and storage (9100A). Single (9100A) or Dual (9105A) 3.5 inch 640K-byte formatted MicroFloppy Drives for software loading, storage and copying. Up to 4 Mbytes or of internal RAM for program and data storage. Plug-in slots for 1 pod and 4 Parallel I/O Modules. Dual RS-232 Interfaces, one system referenced, one earth referenced.
Display: 3 line, 42 characters vacuum fluorescent dot matrix with graphics capability.
Keypad: User keyboard allows access to all functions. Seldom used functions are called with soft keys.

Built-In Tests

RAM: Allows selection of one of three possible tests for finding faults associated with RAM circuitry.
ROM: Reads ROM and computes CRCs and compares with stored CRC.
Bus: Checks the integrity of address, data and control bus.

Built-in Troubleshooting Functions

Read: Reads data from a specified location.
Write: Writes data to a specified location.
Toggle: Toggles a specified data, address or control bit.
Ramp: Ramps the data or address bus over all possible values with a specified starting value and a mask of bits to be ramped.
Rotate: Rotates right a specified starting data word through all possible bit positions.

Probe

Features: CRC signatures with external clock, start, stop, and enable; CRC signatures with external clock, start, and stop generated from a programmable number of clock pulses after start; CRC signatures with the clock from the pod sync; 24 bit transition counting using external start, stop, and enable; Frequency measurement to 40 MHz; Clocked 3-state logic level history using external clock, qualified with start, stop, and enable; Clocked 3-state logic level history using microprocessor pod sync clock; Asynchronous 3-state level history in all modes; Selectable thresholds for TTL, CMOS, and RS-232 levels; Three logic level indicators on the handheld probe body; Probe output drive for high, low or toggle synchronized to pod sync, external clock or free run; Probe response button to signal the mainframe to gather response data; Common lead fused for both the probe and clock module to provide ground fault protection, with blown fuse indication.

Software

Programming: The user creates and debugs test or troubleshooting procedures with the programmer's station option. This gives the user full access to a screen oriented editor and integrated procedure debugger. Test procedures generated on the 9100A can be transported and executed on other 9100A/9105A systems via the 3.5 inch micro-floppy media.
Language: The test language, called TL/1, is used by a test engineer to specify automatic test and troubleshooting procedures. TL/1 is an easily read high level language designed for complete control of the functional test and GFI test environment. The language includes the 9010A language testing concepts. Enhancements are provided in the area of fault handling, UUT initialization and interface to GFI procedures.
Edit/Debug: Procedure editing and debugging are integrated to present a unified means of testing and modifying procedures. The editor is screen oriented, and always provides the user with a current picture of the procedure being edited. The debugger provides many features such as break-point, tracing and access to variables by name.
Guided Probe/Clip Troubleshooting: A menu-driven software package makes it easy for a technician to specify node list information and accumulate signatures from a good UUT. During troubleshooting, this information is used to guide the operator. The operator is told where to place the probe or IC clip to track down the fault.
Executing: The procedure execution environment on the 9100A and the 9105A are identical. Procedures generated on the 9100A will also run on the 9105A. Procedures are transported from the 9100A to the 9015A on a 3.5 inch micro-floppy disk.

Manuals

Getting Started: A description of the parts of the 9100A/9105A, what they do, how to connect them, and how to power up.
Automated Operations Manual: How to run pre-programmed test or troubleshooting procedures.
Technical User's Manual: How to run built-in tests and manual or pre-programmed troubleshooting procedures.
Applications Manual: How to write test or troubleshooting programs using the 9100A's TL/1 programming language.

- TL/1 Reference Manual
- Programmers Manual
- Pod Supplemental Manual

Specifications

9100A/9105A Electrical Specifications

Single Point Probe Input Thresholds

TTL	CMOS	RS-232	
5.0V	5.0V	30V	GUARANTEED HIGH
2.6V	3.7V	3.2V	high or invalid
2.2V	3.3V	2.8V	GUARANTEED INVALID
1.0V	1.2V	-2.8V	low or invalid
0.6V	0.8V	-3.2V	GUARANTEED LOW
0.0V	0.0V	-30V	

Input Impedance: 70 kΩshunted by less than 33 pF

Data Timing for Synchronous Measurement
Maximum Frequency: 40 MHz

Minimum Pulse Width (H or L): 12.5 nsec
Minimum Pulse Width (tri-state): 20 nsec
Setup Times
Data to Clk: 5 nsec
Start, Stop or Enable to Clk: 10 nsec
Hold Time
Clk to Enable: 10 nsec
Clk to Start or Stop: 0 nsec

Data Timing for Asynchronous Measurements
Maximum Frequency: 40 MHz
Minimum Pulse Width (H or L): 12.5 nsec
Minimum Pulse Width Invalid (X)
TTL or CMOS: 100 nsec ±20 nsec
RS-232: 2000 nsec ±400 nsec

Transition Counting
Maximum Frequency: 40 MHz minimum
Maximum Count: 16777215 +overflow
Maximum Stop Count: 65535 clocks

Frequency Measurement
Maximum Frequency: 40 MHz minimum
Resolution: 20 Hz
Accuracy: ±250 ppm ±20 Hz

Output Pulser
High: >3.5V @ 200 mA for less than 10 µs; @ 1% duty cycle >4.5 @ 5 mA continuously
Low: <.8V @ 200 mA for less than 10 µs; @ 1% duty cycle <.4V @ 5 mA continuously

Clock Module Specifications
Input Threshold: 1.6V ±0.2V
Input Impedance: 50K shunted by less than 10 pF

Clock, Start, Stop, and Enable Input Speed
Maximum Repetition Rate: 40 MHz
Minimum Pulse Width: 12.5 nsec

RS-232 Interfaces
One isolated (system referenced)
One non-isolated (earth referenced)
Baud Rates: 110, 134, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200
Parity: Odd, even or none
Data Bits: 5, 6, 7, or 8
Stop Bits: 1, 1.5, 2
XON/XOFF (Ctrl-S/Ctrl-Q): Disable/enable
Clear to Send: Disable/enable
New Line: Carriage Return/Line Feed or Carriage Return

General Specifications

Operating Temperature: 5°C to 27°C 95% RH maximum (non-condensing); 27°C to 40°C; RH decreasing linearly from 95% to 50% (non-condensing)

Storage/Shipping Temperature: -20°C to 60°C; 8% to 80% RH, non-condensing; micro-floppy media limited to 5°C to 60°C, 8 to 80% RH non-condensing

Line Voltage: 90 to 132V ac 47 to 440 Hz; 180 to 264V ac 47 to 63 Hz

Power Consumption: Mainframe, 150W max; monitor, 50W max

Size:
Mainframe: 14.0 cm H x 34.3 cm W x 50.8 cm D (5.5 in x 13.5 in x 20.0 in) Monitor: 30.53 cm H x 33.53 cm W x 33.00 cm D (12.02 in x 13.2 in x 13 in) ASCII Keyboard: 5.02 cm H x 21.15 cm W x 47.2 cm D (2.0 in x 8.33 in x 18.51 in)

Weight:
Mainframe 8.26 kg (18.2 lb)
Monitor 8.44 kg (18.6 lb)
ASCII Keyboard 1.59 kg (3.5 lb)

Safety: Designed to meet the following safety standards: ANSI/UL 478, IEC 348, IEC435, and CSA 5568

Options

9100A-003 Parallel I/O Module

Features:

CRC signatures with Start, Stop, Enable clocked to pod or external clock.

CRC signatures with stop derived from a programmable number of clock pulses after Start. (with TL/1).

Enable can be derived from the external enable line, or from Pod Sync, or can be forced true.

Programmable slopes on clock, start, stop, and enable.

CRC signatures can be taken during overdrive.

Transition counter gated by external Start, Stop, and Enable.

Frequency measurements to 10 MHz.

Clocked level history using external clock; qualified with Start, Stop, and Enable.

Asynchronous level history.

Drive of any arbitrary pattern of 0, 1, or 3-state.

Comparison of any arbitrary 40 bit pattern with a programmable 40 bit pattern of 0s and 1s. True comparison available as a fault within TL/1 programs or as a message during immediate mode operation. The hardware signal (DCE), is also available on the outside of the I/O module.

Logic thresholds switchable between CMOS and TTL.

Family of DIP and SMT logic clip modules with response button to start response gathering.

Common lead fuse protection, for ground fault protection with blown fuse indication.

9100A-017 Vector Output I/O Module
Pins per Module: 40
Maximum Output Rate: 20 MHz
Maximum Pattern Depth: 8192 bits per pin
Input Specifications are the same as the 9100A-003 I/O Module.
Additional information will be available at introduction in March, 1989.

Electrical Specifications

Data Output Specifications:
Current, time >10 mS: ±200 mA
Current, <10 mS: ±2A
Pattern Rate, 1 module driven: 35 kHz
Pattern Depth, (1 module driven during 10 mS high current pattern drive mode): 256 patterns
Max current, per pin (driving high): 275 mA
Max current, per pin (driving low): 150 mA

Data Inputs: Input Impedance: 50 kΩ min

Input Thresholds

TTL	CMOS	
5.0V	5.0V	GUARANTEED HIGH
2.6V	3.8V	high or invalid
2.2V	3.3V	GUARANTEED INVALID
1.0V	1.2V	low or invalid
0.6V	0.8V	GUARANTEED LOW
0.0V	0.0V	

Clock, Start, Stop, and Enable Inputs:
Thresholds: Logic low 0.8V max; Logic high 2.0V min
Input Current: ±1 µA

Input/Output Overvoltage Protection: ±15V for one minute maximum, any pin, one at a time

Transition Counter
Max Frequency: 10 MHz minimum
Max Count (Transition Mode): 8388607 counts (+overflow)
Freq Accuracy (Freq Mode): ±250 ppm ±2 Hz

Stop Counter
Max Frequency: 10 MHz
Max Count: 65535 clocks

Clock
Max Frequency: 10 MHz
Min Pulse Width: 50 nsec

Timing for Synchronous Measurements
Max Frequency of Clock: 10 MHz
Data Setup Time: 30 nsec
Data Hold Time: 30 nsec
Minimum Pulse Width (Start/Stop/Enable/Clock): 50 nsec
Start Edge Setup Time (before clock edge, for clock edge to be recognized): 0 nsec
Stop Edge Hold Time (after clock edge, for clock edge to be recognized): 10 nsec
Enable Setup Time (before clock edge, for clock edge to be recognized): 0 nsec
Enable Hold Time (after clock edge, for clock edge to be recognized): 10 nsec

Data Timing for Asynchronous Measurements
Max Frequency: 10 MHz
Minimum Pulse Width (high or low): 50 nsec
Min pulse width (tri-state): 150 nsec

Data Compare Equal (DCE): Min pulse width of Data and Enable: 75 nsec

Y9100A-100 Card Edge Fixture Kit
Same type as "9100-003 Parallel I/O Mod"

Electrical Specifications
The electrical specifications of this fixture are defined by the electrical specifications of the 9100A I/O Modules and Interface Pods used with it. As long as the design guidelines outlined in the Card Edge Fixture Assembly Manual are followed, use of this fixture will not degrade the performance specifications of the I/O Modules or Interface Pods.

Mechancial Specifications
Size
Height: 14.4 cm (5.875 inches)
Width: 38.6 cm (15.75 inches)
Length: 46.6 cm (19.0 inches)

Ordering Information

Models

January 1989 prices

9100A/SYS Digital Test Programming System 9100A Digital Test System (see below) -004 Programmer's Station (see below) -003 Parallel I/O Module Y9100A-DCS Dip Clip Set (see below)	$24,500
9100A Digital Test System Probe with accessories Clock Module with accessories Manuals Volumes 0-3 System Software Disk #1 and #2 Master User Disk Y8091 10 Micro-Floppy Diskettes Troubleshooting Training Class	15,500
9100A-004* Programmer's Station Programmer's System Disk Monochrome Monitor Manuals Volumes 4 & 5 Video Card (monochrome config.) Video Cable Programmer's Keyboard One 5-Day Training Certificate	6,000
9100A-005* Programmer's Station Less Monochrome Monitor Programmer's System Disk Manuals Volumes 4 & 5 Video Card (color config. IBM color compatible) Programmer's Keyboard One 5-Day Training Certificate	5,800
9105A Digital Test Station Probe with accessories Clock Module with accessories Manuals Volumes 0-3 System Software Disk #1 and #2 Master User Disk Y8091 10 Micro-Floppy Diskettes	10,000

**If purchased separately for installation in a previously purchased unit, orders must be placed through a Customer Service Center. An additional installation charge will be added to the price.*

9100A/9105A Options†

9100A-003 Parallel I/O Module	$2750
9100A-009 Monochrome Video	800
9100A-011 Color Video Card	500
9100A-013 Keyboard	250
9100A-017 Vector Output I/O Module ... Available March, 1989. Contact Factory for pricing.	
910XA/SS Test Station Software Support Agreement	700
9100A/SYS/SS System Software Support Agreement	1800

9105A Options†

9105A-007 512K Memory Expansion	600
9105A-008 Real-time Clock	250

†See option compatibility chart on page 182

Accessories

Y8091 3.5 inch Micro-Floppy Diskettes	85
Y9100A-14D High Quality Dip Clip Module, 14 Pin	185
Y9100A-14S Small Outline Clip Module, 14 Pin	185
Y9100A-16D High Quality Dip Clip Module, 16 Pin	185
Y9100A-16S Small Outline Clip Module, 16 Pin	185
Y9100A-18D High Quality Dip Clip Module, 18 Pin	215
Y9100A-20D High Quality Dip Clip Module, 20 Pin	220
Y9100A-20S Small Outline Clip Module, 20 Pin	215
Y9100A-24D High Quality Dip Clip Module, 24 Pin	230
Y9100A-24S Small Outline Clip Module, 24 Pin	230
Y9100A-28D High Quality Dip Clip Module, 28 Pin	280
Y9100A-28S High Quality Dip Clip Module, 28 Pin	$280
Y9100A-40D High Quality Dip Clip Module, 40 Pin	300
Y9100A-100 Card Edge Fixture Kit	250
Y9100A-101 Card Edge Fixture Base	200
Y9100A-102 Card Edge Interface Module	200
Y9100A-7201 Probe Accessory Kit Contains: One Probe Tip One Probe Tip Cable Assembly One Large Ground Clip Hook One Ground Cable Assembly Eight Small Clock Module Clips	50
Y9100A-DCS DIP Clip Set One Y9100A-14D One Y9100A-16D One Y9100A-18D One Y9100A-20D One Y9100A-24D One Y9100A-28D One Y9100A-40D	1300

Service & Support

Warranty

90-day product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-9100A Repair	360
SC1-9100A/Sys Repair	630
SC1-9100A-003 Repair	150
SC1-9100A-004 Repair	120
SC1-9100A-005 Repair	50
SC1-9100A-009 Repair	100
SC1-9100A-011 Repair	40
SC1-9105A Repair	240

9132A

NEW

9132A

9132A Memory Interface Pod

- Support for 32-bit designs
- Fluke's new HyperTEST™ RAM test algorithm
- Advanced diagnostic capability for isolating bus faults
- Quick memory tests

The 9100A Digital Test System now supports advanced 32-bit designs with the new 9132A Memory Interface Pod. The pod can be adapted quickly and inexpensively to accommodate future microprocessor support needs with only a microprocessor-specific personality module and software disk.

The 9132A connects to the 9100A mainframe in the same way as other Fluke pods to stimulate and test UUT circuitry, but uses a new pod technology. Connection is made through a sync module and by replacing the UUT boot ROMs with ROM modules. The 9132A accesses and controls the UUT's microprocessor through the boot ROM sockets. Instructions are passed through the ROM modules stepping the UUT microprocessor through various built-in and user-written tests. Similar to the user interface for other Fluke pods, the 9132A can be controlled through commands written in high-level language, rather than requiring the user to generate microprocessor-specific assembly code.

Built-In RAM Tests

Thorough testing of the large amounts of memory common to 32-bit designs can take a significant portion of total test time. The 9132 addresses this by incorporating the new high-speed HyperTEST™ RAM test algorithm (patent pending). HyperTEST is immediately executable and can test one megabyte of the UUT's RAM in as little as one second.

Bus Test

In addition to the standard ROM and RAM tests available through the pod's basic WRITE and READ functions, each 9132A processor support package includes a microfloppy containing 9100A programs which provide advanced diagnostic capability in isolating bus faults, and a sync module adapter to help speed up the fault-finding process.

Processors Supported

(for 9100 mainframes)

80386 and 68020. As Fluke develops new microprocessor interfaces, the personality module, database, and microprocessor-specific user's manual will be made available. Check with your Fluke Sales Representative for a current list of processors supported.

ROMs Supported

24 Pin			
2716	2732	2732A	2364A
2366	5366		
28 Pin			
2764	27C64	2364E	23C64E
2365	3864	5365	27128
27C128	23128	23128E	23C128
23C128E	38128	27256	27C256
23256	23C256	53257	27512
27C512	38512	23C1000	531000
32 Pin			
271000			

Ordering Information

Models	January 1989 prices
9132A Memory Interface Pod	$3200
9132A-80386 80386 Processor Support Pkg	1000
9132A-68020 68020 Processor Support Pkg	1000
9132A-024* ROM Module, 24 Pin	800
9132A-028* ROM Module, 28 Pin	800
9132A-032* ROM Module, 32 Pin	800
9132A-100** RAM Module	500

**One needed for each UUT Boot ROM*
***One required for each ROM Module, up to 4 maximum*

Minimum configuration is one 9132A Memory Interface Pod, one Processor Support Package, one ROM Module and one RAM Module. Check with your Fluke Sales Representative to ensure accurate order configuration.

9000 Series

GPIB
IEEE-488

RS-232

9010A Micro-System Troubleshooters

Partial List of Processors Supported

Z80A
Z80B
Z8001
Z8002
Z8003
Z8004
1802
1804
1805
1806
6502
6800
68000
68010
6802
6802NS
6808
6809
6809E
8031
8032
8035
8039
8040
8041
8041A
8042
8044
8048
8049
8050
8051
8052
8080
8085A
8085-2
8086
8088
8344
8741
8741A
8742
8744
8748
8749
8751
9900
80186
80188
80286

The 9000 Series Micro-System Troubleshooters – 9005A, 9010A, and 9020A – are among the most comprehensive troubleshooting instruments ever developed for locating faults on microprocessor-based systems. They include built-in preprogrammed test routines for checking the entire microprocessor kernel: bus, RAM, ROM, and I/O. Included is a troubleshooting probe that you can use either to monitor logic action on a node-by-node basis or to inject stimulus pulses.

The three troubleshooters differ primarily in their programming and system capabilities.

The 9010A is a self-contained, programmable model that lets you develop your own customized test programs. Using the 9010A, you can perform specialized guided fault-isolation routines on any portion of a board's digital circuitry.

The nonprogrammable 9005A includes the same built-in tests as the 9010A but cannot generate new test routines. It can, however, run test sequences developed on the 9010A and transferred from a minicassette tape. With the optional RS-232C interface, you can also download test sequences directly from the 9010A or a host computer. Typically, you would develop guided fault-isolation programs at a central location, using a 9010A, and then run the programs at remote sites on 9005As.

The 9020A, designed for systems use, runs test programs written and stored in a system controller or other computer. You can also combine the 9020A with other test instruments to troubleshoot complex microprocessor-based products with special measurement and control problems. The 9020A has no programming keys or cassette tape capability, so test sequences must be executed through the RS-232C or IEEE-488 port.

Read/Write Emulation

The 9000 Series Micro-System Troubleshooters eliminate tedius, manual probing techniques. Instead, they take control of the unit under test by plugging into its microprocessor socket. They then emulate the actions of the microprocessor, both reading data from and writing data to the unit's RAM, ROM, and I/O addresses.

9000 Series Micro-System Troubleshooters

- Preprogrammed kernel test routines
- Simple peripheral troubleshooting
- Keyboard data entry
- 32-digit display
- Power-up self-test
- Keystroke programming (9010A only)
- Language compiler optional (9005A and 9010A)
- Communications interface (RS-232C is optional for 9005A and 9010A; either RS-232 or IEEE 488 is standard for 9020A)
- FREE Troubleshooting Course with purchase!

Special Functions

A. Preprogrammed functional tests, offer structured testing and troubleshooting of the µp's BUS, RAM, ROM and I/O Registers.

B. TROUBLESHOOTING functions: simple READ and WRITE commands allow you to stimulate and observe responses from peripheral interphase adapters (PIAs, CTCs, and UARTs) and circuitry beyond the µP bus. Several special functions are available (RAMP, WALK) with preprogrammed stimulus sequences.

C. Optional RS-232: easy downloading of programs and test results to storage mediums, printers and other testers at remote locations. Optional IEEE-488* for computer controller operation (9020A).

D. TAPE deck controls for storing and reading programs and UUT memory maps on the mini-cassette.

E. LEARN function which is used on a "known good" system, finds and maps RAM, ROM and read/writable I/O addresses.

F. Hexadecimal entry of address descriptors.

G. MODE control of tests and programs.

H. TEST SEQUENCING and ARITHMETIC keys for creating unique user-generated test routines.(9010A only.)

I. PROBE controls used for synchronizing the troubleshooting probe to µP cycles and to drive nodes high and/or low.

J. Pod design provides for safe easy use – Extensive input protection prevents damage to the pod from common accidental abuses such as plugging the pod into the socket backwards. Plug is inserted into socket on pod for self-test. Pins can be protected there when not in use.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Built-in Tests

Fluke has taken the trouble out of verifying that the kernel – the heart of the microprocessor system – is operating properly, by including built-in kernel tests in all the 9000 Series Troubleshooters. These tests, initiated by a single keystroke, check the electrical integrity of the microprocessor bus, the read/write capability of the I/O registers, the data in ROM, and RAM operation. A fifth built-in test provides more extensive RAM tests when necessary, checking for pattern-sensitive failures.

The five tests, which cover more than 50% of the components on most boards, check for the problems that are often the most difficult to identify and isolate – including failures that lock up the microprocessor bus. Even if the troubleshooters had no other capabilities, the time saved by these built-in tests alone would more than justify their cost.

Of the five built-in tests, you should run the bus test first, since it verifies the integrity of the microprocessor's basic communication network. To test the remainder of the kernel, you need to enter the address range of RAM, ROM, and I/O for the unit under test, so the troubleshooter will know what addresses to read from and write to. You can enter this information manually through the front-panel keyboard or read it from a minicassette – or, if you have the RS-232C interface, you can download it from a host computer or system controller. If address information is not readily available from the unit's documentation, there is a LEARN algorithm to let you generate a memory map from a known-good board. Once entered, memory-map information can be stored on a minicassette for later use (9005A/9010A).

Beyond the Bus

The 9000 Series Troubleshooters aren't limited to finding kernel-related problems: they can also isolate failures in synchronous circuitry outside the bus. The troubleshooting probe that comes with the 9000 Series will help you track such off-the-bus failures to their source. This probe is a powerful fault-finding tool, useful both for monitoring logic action and for injecting stimulus pulses.

In monitoring, or response mode, the troubleshooting probe takes signatures, counts events, and shows high/low logic states in each node probed. In stimulus mode, it can inject high or low pulses to stimulate readouts, print heads, interfaces, or other devices. Driven by a sync pulse from the interface pod, the probe can be synchronized to various microprocessor events, such as valid address or data periods on the microprocessor bus. You can also choose to use it in "free run" mode, injecting 1 kHz pulses at the contacted nodes.

To further extend the capabilities of the troubleshooting probe, add the asynchronous signature option. This option lets you test asynchronous circuits located outside the microprocessor bus structure (such as DMA controllers, video controllers, and video-generation circuits) without using a logic analyzer or oscilloscope. Tests performed include signature gathering, waveform capture, and event counting. For more information, see the description of the Asynchronous Signature Probe Option.

Custom Test Programming on the Fluke 9010A

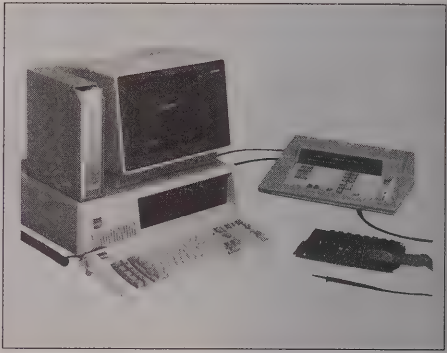
The 9010A lets you write your own comprehensive test routines tailored to the unique characteristics of the equipment you service. These programs can include prompting messages to help guide your technicians through the test procedures. Once written, your test programs can be stored on minicassettes for later use – or for downloading to a 9005A.

You can generate your own test software in two ways. First, you can develop short programs right on the 9010A's keyboard, in much the same way as with a scientific calculator. Second, for more extensive test routines, you can use the 9010A's Language Compiler, developing programs off-line on a personal computer and then downloading them to either a 9010A or 9005A. The Compiler runs on a number of popular personal computers, including the IBM® PC and Kay Pro II® as well as on the Fluke 1720A and 1722A Instrument Controllers. For more information, see the description of the Language Compiler on page 175.

A Powerful Test System Using the Fluke 9020A

The combination of a Fluke 9020A Micro-System Troubleshooter with an IBM or IBM-compatible personal computer and Fluke's TestWriter™ software (see page 176 for more information) gives you a powerful system for performing large-scale guided fault-isolation. In this system, the 9020A is used to stimulate and gather response information from the unit under test; the personal computer acts as both the system controller and the storage medium; and the TestWriter software minimizes programmer time through simplified data-entry procedures.

This test configuration makes developing test programs so easy that it opens the door to new types of tests – tests that previously would have required too much programming time to be cost-effective. And it makes performing the tests so simple that virtually any technician can immediately begin troubleshooting, without going through the extensive training required to use more traditional test techniques.



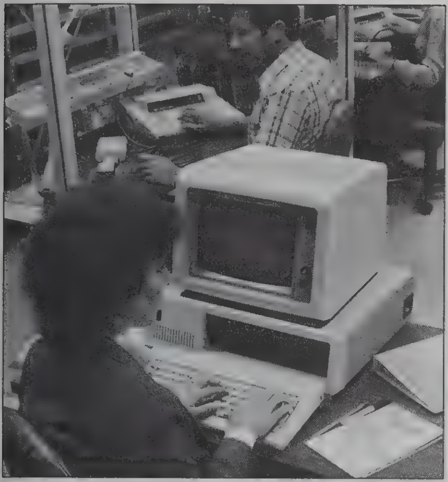
Options and Accessories

9000A-910 Utility Tape

The 9000A-910 Utility Tape contains many programs designed to enhance the operation of the 9010A. These include:

- Merge Tape – Lets you read specific programs from a minicassette tape, renumbering them as desired and merging them with programs already in the 9010A. With this utility, you can combine programs from two or more tapes onto a single tape.
- Frequency Counter – Lets you use the troubleshooting probe to measure frequencies of up to 6 MHz.
- Setup – Lets the 9010A operator make changes in the setup menu while the system is under program control.
- Probe Pulser – Lets the 9010A operator change pulser status while the system is under program control.
- Register Addition and Subtraction – Allows for the addition or subtraction of the contents of two registers while the system is under program control.

The Utility Tape comes with a manual and one minicassette that describes how to use each of these programs.



9010A Language Compiler

If your test routines are short, you can develop them right at the keyboard of the 9010A. For more extensive test routines, you'll find it easier to work off-line on a personal computer, using the 9010A Language Compiler and downloading the results to the 9010A.

The Language Compiler lets you write extensive test and troubleshooting routines more quickly and conveniently. The Compiler is available in several versions, offering compatibility with the following computer systems:

- IBM® Personal Computer (9010A-923)
- Kay Pro® II (9010A-922)
- Fluke 1720A and 1722A Instrument Controllers ((9010A-920)

Sophisticated development tools come with the Compiler to speed the program-development process. Using these features, you can:

- Share common test routines among multiple programs through a File Inclusion feature, linking them together automatically at compile time.
- Save time when entering code by using keyword abbreviations, optional command keywords, and shorthand notations.
- Assign symbolic names to your programs, labels, and registers, making it easier to understand and remember the purpose of the different program sections.
- Document programs with comments imbedded within the program listing, making them easier to follow should you later wish to revise them.

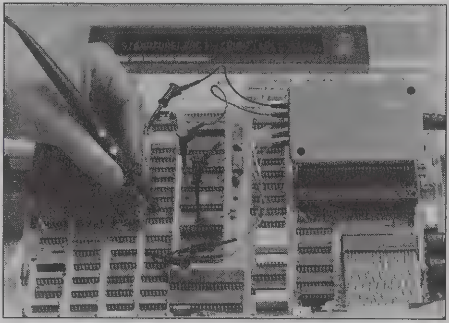
9000A-006 Asynchronous Signature Probe Option

The 9000A-006 Asynchronous Signature Probe Option gives you high-powered fault isolation capabilities for asynchronous circuits located outside the microprocessor bus structure. With this option, you no longer need to augment your 9000 Series Troubleshooter with a logic analyzer.

By adding the Asynchronous Signature Probe to the 9000 Series, you gain the ability to perform real-time measurement of such asynchronous circuits as:

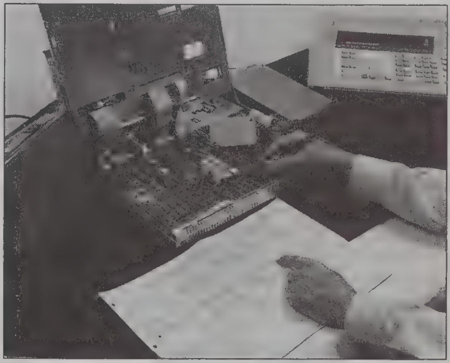
- DMA controllers
- Video controllers
- Video-generation circuits
- Communication circuits
- Peripheral controllers

The Asynchronous Signature Probe provides three distinct troubleshooting measurements:



- Signature gathering, using the cyclic redundancy check technique.
- Waveform capture, in which the probe-tip data stream is sampled every 20 nanoseconds for a total of up to 32 data samples. The results of this sampling are both displayed and stored.
- Event counting, a powerful tool for node characterization. Using this feature, you can count events from the probe tip, either continuously or through a measurement window. A 24 bit register allows you to record over 16 million events.

The Asynchronous Signature Probe consists of a circuit board, installed in the 9000 Series mainframe; a clock module, which picks up timing and control signals from the unit under test; and a special set of operating programs contained on a minicassette tape.



FREE Training Certificate Program

When you purchase any of the 9000 Series models, you will receive, upon request, a special certifcate entitling you to the 9010 Board Tester Troubleshooting course. You will enhance your troubleshooting proficiency and become productive even faster with this program.

9020A-925 TestWriter

Fluke's TestWriter software, combined with the 9020A Micro-System Troubleshooter, an interface pod, and an IBM (or IBM-compatible) personal computer, makes it easy to develop guided fault-isolation or automated diagnostic programs for digital circuit testing. In this configuration, the personal computer, communicating with the 9020A-001 through its RS-232C interface, acts as both a system controller and a storage medium.

TestWriter offers the best of both worlds in regards to program generation and execution. Programmers will welcome TestWriter's time-savings and simplified data entry procedures. Operators will appreciate the use of menus in directing the testing process, as well as the easy-to-read graphic feedback of the testing process.

TestWriter's ability to automatically generate a fault tree eliminates the tedious time-consuming process of entering individual decision statements when structuring a program. The programmer simply enters UUT descriptive information: the component types and their interconnectivity. This time-saving feature, together with the increased memory capacity in the PC is what makes TestWriter extremely effective when generating large GFI programs.

The test engineer proceeds by developing a set of stimulus routines; one and, sometimes, several for each node on the UUT.

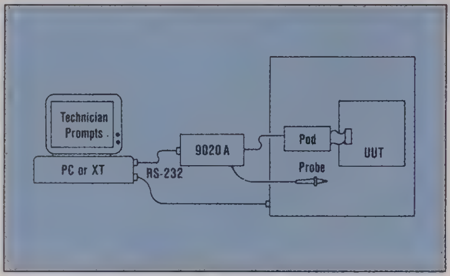
The last step in completing the GFI program is to gather responses on each node of a "known good" UUT while stimulated by the corresponding stimulus routine(s). These responses are stored in a separate file which will be used for comparison with responses from a defective board during the fault isolation process.

TestWriter also simplifies the process of troubleshooting defective units. The operator makes selections from menus, aided by prompts and graphic displays. The personal computer automatically sends the appropriate commands to the 9020A and records the responses. It also provides a graphic display of the node that the operator is probing, along with the other points that drive that node.

As each nodal measurement is taken, the display will show whether the response was GOOD or BAD. The software will continue to ask for probe points until it can make a decision on the cause of the problem. Once made, this decision is displayed on the CRT.

For cases where the operator is experienced in troubleshooting a particular board, TestWriter also allows unguided fault isolation, in which the operator decides the order in which nodes are to be tested.

Test Station Configuration

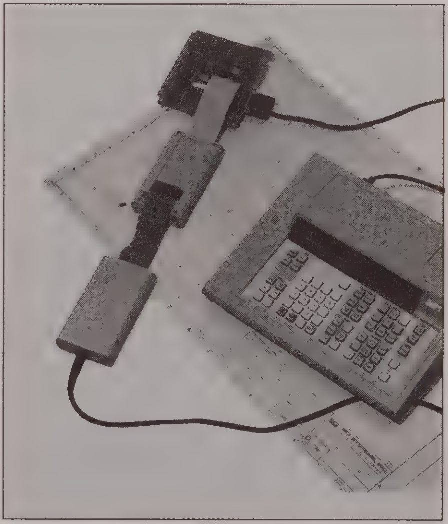


9010A/GF Upgrade Kit

This kit, in conjunction with the 9010A-001 (RS-232C interface port), transforms a 9010A into a dual purpose unit: it will continue to function as a standard 9010A and, in addition, can function as a 9020A-001. As a 9020A, this unit can operate with the above described TestWriter software, which executes on an MS-DOS compatible personal computer.

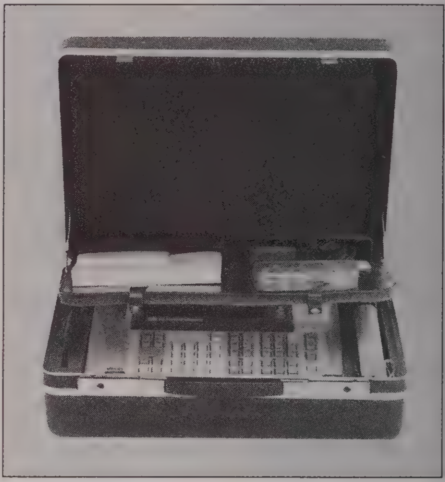
This upgrade kit allows you to execute all existing test procedures on the 9010A and expands its utility by offering you the ability to interface it with a pc and utilizing the power of the TestWriter software system.

The upgrade may be ordered as a kit for Fluke field service center installation in your unit or can be ordered factory installed for new units. The installation adds an internal module and a switch labeled GFI (Guided Fault Isolation) on the rear panel. In the GFI-ON mode the 9010A with 9010A/GF option behaves as a 9020A.



Transit Cases

Lockable hard case holds 9000 Series pod, probe, accessories, four mini-cassette tapes, and user's manual. Foam-lined, sturdy construction.



Specifications

Technical Specifications

Display: Vacuum fluorescent; displays up to thirty-two 14-segment alphanumeric characters at once.

Self Test: All 9000 Series units perform self-tests at each power-up, verifying proper operation of internal RAM, ROM, clock, power supply, display, and communications with interface pod. Pod has own self-test socket to verify proper operation at microprocessor plug.

Test Speed: Tests run at full system speed, based on clock in unit under test.

Keyboard Data Entry: Hexadecimal 0 through 9 and A through F.

Mag Tape: (9005A and 9010A only). Minicassette tapes store all "learned" data plus test programs generated on-line for off-the-bus testing. One tape holds up to 12K bytes – the same as internal memory on the 9005A and 9010A. Both units come with a built-in tape drive.

Interface Pod: Plugs into 9000 Series mainframe; must match type of microprocessor used in circuits being tested. Pods available for 8-bit and 16-bit microprocessors. Special circuitry protects pods from damage even if plugged in backwards.

Troubleshooting Probe: Plugs into 9000 Series mainframe. In response mode, takes signatures, counts events, shows logic states; in stimulus mode, injects either clock-synchronized or 1 kHz pulses. Measurement thresholds are 0.8V (low), 2.4V (high). Stimulus pulses are <0.2V at 100 mA (low), >4V at 100 mA (high). Probe is protected to ±30V.

Automatic Functions Summary

Learn Mode: (9010A and 9020A only). Uses a known-good system of same type as unit under test to locate and determine size of RAM, ROM, and read/writeable I/O registers, and to compute signatures. Stores results in memory for immediate comparison to circuits being tested; data can also be saved on minicassette or (with RS-232C option) downloaded to another system or device.

Built-In Kernel Tests: Using data entered either automatically through Learn mode or manually through the keyboard, the 9000 Series Troubleshooters can perform the following tests of kernel circuitry (each initiated by a single keystroke):

- BUS – Checks electrical integrity of address, data, and control lines; isolates stuck nodes and adjacent-trace shorts.
- RAM SHORT – Checks each RAM location for ability to read and write; verifies address decoding; detects data-line shorts beyond bus buffers.
- ROM – Computes ROM signatures and compares them with those in the known-good unit.
- I/O – Checks each I/O register identified in the known-good system to make sure it is read/writeable.
- AUTO – Runs all the above tests; initiated by a single keystroke. (Typically requires several minutes, depending on size of memory being checked.)
- RAM LONG – A more complex RAM test, used to isolate "soft" or pattern-sensitive RAM faults.

In addition, 9000 Series Troubleshooters continually monitor the power supply of the unit under test for out-of-tolerance conditions as well as the UUT clock signal. An error message is displayed if they detect a defect.

Troubleshooting Functions Summary

The following function keys are available on the 9000 Series Micro-System Troubleshooters:

- READ – Displays data contents of specified address.
- WRITE – Writes specified data to any address location.
- WALK – Writes automatic walking pattern to specified address.
- RAMP – Writes automatic binary incrementing ramp to specified location.
- TOGGL DATA – Pulses specified data bit between high and low state.
- TOGGL ADDR – Pulses specified address bit between high and low state.
- TOGGL DATA, then STS/CTL – Pulses specified control bit between high and low state.
- READ PROBE – Displays probe measurements, including signatures, logic states and event counts.
- SYN – Allows probe measurements or stimulus to be either asynchronous or synched to valid address or data periods on the microprocessor bus.
- HIGH (Pulse) – Activates high-going pulses. The frequency and width of the pulses depend on the sync mode selected.
- LOW (Pulse) – Activates low-going pulses. The frequency and width of the pulses depend on the sync mode selected.
- HIGH and LOW toggle – Pulses alternate between high-going and low-going.

Also, a scope trigger-signal of about 100 mV amplitude can be synchronized with address or data sync pulses from the mainframe.

Test-programming Functions Summary (9010A)

(Not applicable to 9020A; available in execute-only mode on 9005A.) Users wishing to troubleshoot beyond the system kernel into peripheral devices can write and edit test programs tailored to the unique architecture of the systems they work with. The following keys are available for on-line programming:

- PROGM – Opens and closes test programs (both for development and for editing).
- EXEC – Runs selected test program.
- DISPL – Allows programs to include operator prompts (e.g., PROBE U6 PIN 7).
- Sequencing keys (IF, > =, GOTO, LABEL) Available for comparison, branching, looping, and labeling steps in the test program.
- Arithmetic keys – Eight logical operations available for arithmetic control of mainframe registers that store user-specified address and data information during program writing.
- Editing keys – Allow the operator to scroll backwards or forwards through the programming steps.

Mode Control Summary

Mode control keys give operator control over all functions: automatic tests, programmed tests, and troubleshooting operations. The following mode control keys are available:

- STOP – Halts current test or operation.
- RPEAT – Causes test or operation to repeat once.
- CONT – Advances to next test step or continues last operation.
- LOOP – Continuously repeats a functional test, programmed test step, or troubleshooting command or loops on any fault.
- RUN UUT – Allows full exercise of both the self-diagnostics and normal run operation of the unit under test, with the pod microprocessor acting as the processor of the unit being tested.

General Specifications

Temperature: 0°C to +50°C operating temperature (+10°C to +40°C for minicassette); -40°C to +70°C non-operating temperature (+4°C to +50°C for minicassette)

Power: 100, 120, 220, 240V ac ±10%; 50 Hz, 60 Hz ±5%; 40W maximum

Size: 11.5 cm H x 35.5 cm W x 30.5 cm D (4.5 in H x 14 in W x 12 in D)

Weight: 6 kg (13 lb) mainframe; 0.7 kg (1.5 lb) per interface pod

Included: Probe, probe accessories, two minicassettes (none with 9020A), manuals, power cord

Ordering Information

Models

January 1989 prices

9005A Micro-System Troubleshooter	$3190
9010A Micro-System Troubleshooter w/Program Functions	5290
9020A-001 Micro-System Troubleshooter w/RS-232-C Interface	5590
9020A-002 Micro-System Troubleshooter w/IEEE-488 Interface	5590

Options† (For 9010A & 9005A)

-001* RS-232-C Interface	450
-910 Utility Tape	95
-920 Language Compiler compatible w/Fluke 1720A & 1722A Instrument Controllers	495
-922 Language Compiler for Kay Pro® II	495
-923 Language Compiler for IBM Personal Computer	495
9010A/GF* Kit (field-installed)	495
9010A/GF Kit (factory-ordered)	495

Options (For 9010A, 9005A & 9000A)

-006* Asynchronous Signature Probe	995

Options (For 9020A and 9010A/GF)

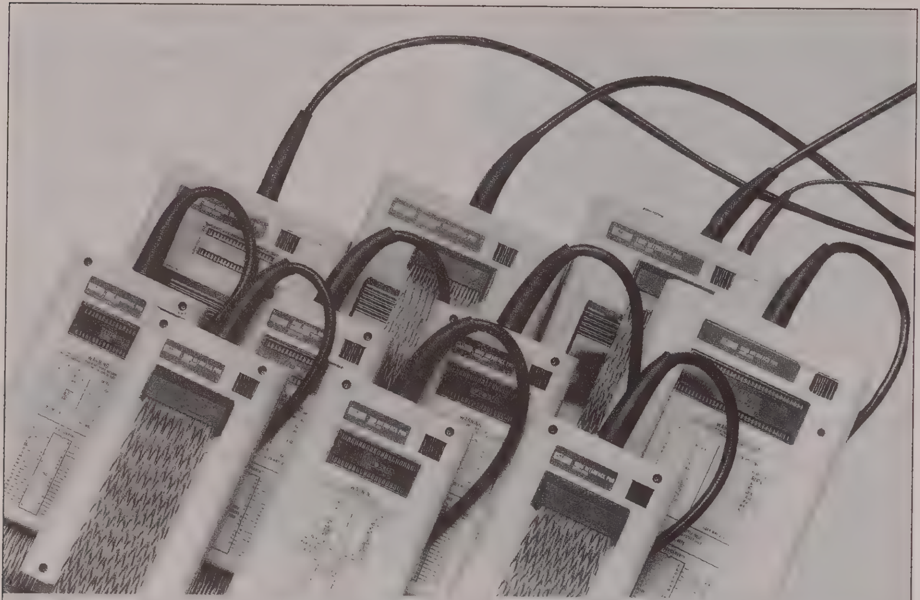
-925 TestWriter Software	1500

Accessories

9000A-200 Pod Adapter Packaging Kit	195
9000A-900 Transit Case	295
Y8007 Ten-Pack of Mini-cassettes	150

**Service Center installable only. Other user-installable.*
†See option compatibility chart on page 182

9000 Series Interface Pods



Micro-System Troubleshooters Interface Pods

Interface Pods

- 50 microprocessors supported
- Adapter kits available for other microprocessors
- Easy connection to unit under test
- Intelligent pods with built-in software*
- Quick memory tests*
- Quick looping Reads and Writes*
- Built-in self-diagnostics

**Available on some pod models only. See Table 1 for a listing of pods offering these features.*

How the Interface Pod Works

The interface pod functions as the test interface between the suspect circuit board and the troubleshooter mainframe, adapting the general architecture of the mainframe to that of the specific microprocessor system under test. When you plug the pod into the unit under test, you are effectively replacing the microprocessor in that unit with the micro-processor in the pod.

This unique test connection gives the Fluke troubleshooter mainframe the ability to access board and system components directly, through the central control element of the entire system – the microprocessor. As a result, you get exceptionally high-confidence test results.

Unlike emulators and development systems intended for software debugging, these interface pods are designed specifically for hardware troubleshooting. Each pod is a self-contained system with its own microprocessor, RAM, ROM, and I/O memory space. This means that the unit being tested does not need to be operating for the Fluke troubleshooter to begin testing. It also means that you can test for multiple faults by simply disabling each faulty line as it is identified and continuing to run the tests.

Each pod includes a RUN UUT function to let you test the unit's operation as though it were operating under its own microprocessor. When this function is activated, it electrically disconnects the unit being tested from the tester, letting it perform as if its microprocessor were still in the socket.

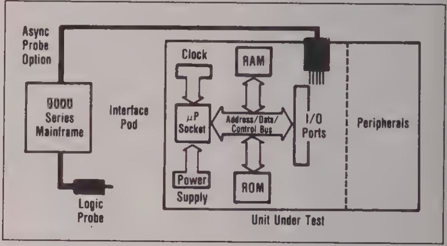
Microprocessors Supported

Fluke interface pods currently support an extensive range of microprocessors, as shown in Table 1. New pods are added regularly to support additional microprocessors as they are introduced.

IBM is a registered trademark of International Business Machines Corporation.

Kay Pro II is a registered trademark of Non-Linear Systems, Inc.

The interface pod obtains its clock signal from the unit under test and runs at the same speed as the unit. Since manufacturers often build a particular microprocessor in different versions, each running at a different clock speed, Fluke selects the fastest clock speed available when designing its pods. This ensures the pod's ability to test any processor in that family, regardless of clock speed.



Advanced Pod Features

As microprocessor technology advances, Fluke has made its pods correspondingly larger and more powerful. Accordingly, the newer pods (indicated by an * in Table 1) offer advanced features not available in some of the earlier models. These include more intelligence, interrupt features, quick memory tests, and quick looping read and write tests.

Table 1. Microprocessors Supported by Fluke Interface Pods

System µP	Pod Model #	System µP	Pod Model #
Z80A	9000A-Z80	8041A	9000A-8048*
Z80B	9000A-Z80/AA	8042	9000A-8048*
Z8001	9000A-Z8000*	8044	9000A-8051*
Z8002	9000A-Z8000*	8048	9000A-8048*
Z8003	9000A-Z8000*	8049	9000A-8048*
Z8004	9000A-Z8000*	8050	9000A-8048*
1802	9000A-1802*	8051	9000A-8051*
1804	9000A-1802*	8052	9000A-8051*
1805	9000A-1802*	8080	9000A-8080
1806	9000A-1802*	8085A	9000A-8085
6502	9000A-6502	8085A-2	9000A-8085
6800	9000A-6800	8086	9000A-8086*
68000	9000A-68000*	8086	9000A-8088*
68010	9000A-68000*	8344	9000A-8051*
6802	9000A-6802	8741	9000A-8048*
6802NS	9000A-6802	8741A	9000A-8048*
6808	9000A-6802	8742	9000A-8048*
6809	9000A-6809	8744	9000A-8051*
6809E	9000A-6809	8748	9000A-8048*
8031	9000A-8051*	8749	9000A-8048*
8032	9000A-8051*	8751	9000A-8051*
8035	9000A-8048*	80186	9000A-80186*
8039	9000A-8048*	80188	9000A-80188*
8040	9000A-8048*	80286	9000A-80286H*
8041	9000A-8048*	9900	9000A-9900

** Incorporates one or more advanced features (see discussion under "Advanced Pod Features" in this section.)*

Note: For microprocessors not found in this table, contact your local area Fluke Sales Office or Representative for a copy of Technical Data B0156, "User-Designed Interface Pod Adapters."

More Intelligence. Many of the newer pods feature additional built-in software, enhancing the troubleshooting and test capabilities of the mainframe. With this software, the user need only send the test parameters to the pod from the troubleshooter mainframe. The pod will independently execute the specified function, providing much faster test results than is possible with mainframe execution.

Interrupt Features. Some of the newer pods also have interrupt testing capabilities, allowing them to read information from received interrupts. The user can control the configuration of the pod's interrupt lines, enabling and disabling interrupts and forcing interrupt-acknowledge cycles.

Quick Memory Tests. Fluke has increased the speed of memory testing in many of its newer pods, including the 8051, 8086, 8088, Z8000, 68000, 80186, 80188, and 80286 building Quick RAM and Quick ROM tests into the pod software. In addition to greatly reducing the test time, these tests provide:

- A choice of byte or word test for the 16-bit microprocessors
- A choice of address increment size
- More flexibility under program control

The Quick RAM test consists of two parts. The first rapidly tests the read/write capabilities of either small segments of memory or the entire block of RAM. The second, a pattern verification test, verifies that memory addresses are being properly decoded and checks dynamic RAM memory for refresh problems, verifying its ability to retain accurate information.

The Quick ROM test uses a checksum procedure to test the ROM for faults. It also finds any inactive data bits (bits that always read high or low regardless of the ROM address selected).

Quick Looping Read or Write. The Quick Looping Read or Write function rapidly performs continuous Reads or Writes at a specified address. This feature lets you easily view bus signals on an oscilloscope synchronized to the TRIGGER OUTPUT pulse (located on the rear panel of the Troubleshooter). By increasing the repetition rate of the oscilloscope trace, this function makes the trace signal brighter and therefore easier to see.

HyperTEST™ RAM Test Algorithm

Thorough testing of the large amount of memory commonly available with the newer 16-bit processors can take a significant portion of the total test time. The 9000-80286H pod addresses this by incorporating Fluke's new high-speed HyperTEST™ RAM Test Algorithm (patent pending). HyperRAM can be executed in immediate mode as well as under program control. It can test one megabyte of the UUT's RAM in as little as one second.

Special Circuitry

Because the pod is intended to be used with defective micro-systems, Fluke designed it with special input protection circuitry. This circuitry provides overvoltage protection on each line to the unit under test – even if the pod is plugged in backwards. Other pod circuitry monitors and checks each read/write operation as it is performed. A self-test socket is included for verifying proper pod function.

Pod Adapter Packaging Kit

Allows testing of many microprocessor systems not directly supported by a Fluke interface pod. Consists of all the parts necessary to house the adapter circuitry, to connect the pod to the adapter, and to connect the adapter to the UUT.

Ordering Information

Interface Pods

	January 1989 prices
9000A-Z80	$1190
9000A-Z80/AA	1390
9000A-Z8000*	2090
9000A-1802*	1690
9000A-6502	1190
9000A-6800	1190
9000A-6802*	1190
9000A-6809*	1590
9000A-8048*	2090
9000A-8051*	2090
9000A-8080	1190
9000A-8085	1190
9000A-8086	2590
9000A-8088	2590
9000A-9900	2090
9000A-68000*	2590
9000A-80186	3090
9000A-80188	3090
9000A-80286H	3590

**Each of these pods supports a family of microprocessors.*

Accessories

9000A-200 Pod Adapter Packaging Kit	195
9000A-201 8051 Clip-on Adapter	95
Y9000A-80286-7202 PLCC Clip-on Adapter	395

Service & Support

Warranty

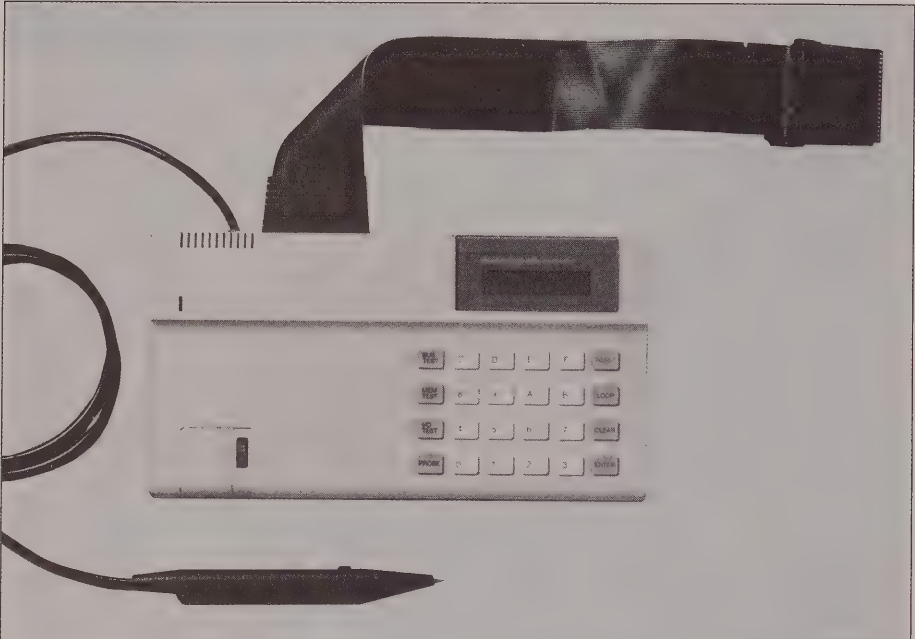
One year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty*

SC1-9000A-Z80 Repair	151

**Extended Warranty available on other pods also.*

90 Series



90 Series

90 Series µP Board Tester

- QuickTrace™ to automatically test, identify and follow the microprocessor's address, data and control lines
- A logic probe for isolating faults at nodes not directly connected to the microprocessor
- Bus Tests to determine if any bus line is stuck high or low or shorted to other bus lines
- Memory Tests to determine if RAM can be properly written and read, and if ROM contains the proper bit patterns
- I/O Tests to determine if I/O addresses can be written and read
- The detection and trapping of selected events with the Break-Point, Frame-Point, and External Trigger functions, as well as Memory Upload and Download

The Fluke 90 Series is a family of compact, powerful, inexpensive testers for isolating and diagnosing faults in microprocessor-based products and systems. The 90 Series is completely self-contained and clips directly onto the microprocessor in the Unit Under Test (UUT). This clip-on reduces test setup times, and allows systems with soldered-in microprocessors to be tested and serviced.

Pre-Programmed Tests

The 90 Series is pre-programmed with a battery of tests that find UUT problems quickly. These tests are selected from easy to understand menus, virtually eliminating training time. Starting at the UUT's kernel and working through the busses to memory and peripheral devices, these tests allow the operator to quickly isolate system faults. 90 Series tests are divided into four basic groups:

Bus Tests

Isolate bus lines stuck high or low, or bus lines shorted to other bus lines.

Memory Tests

Test system RAM and ROM. These tests do not interrupt UUT operation. Other tests examine and modify memory contents, or exercise memory mapped peripherals while the UUT is operating.

I/O Tests

Examine and modify the contents at I/O addresses or exercise peripherals while the UUT is operating.

Probe Tests

Isolates shorted or stuck address, data and control lines. Quick Trace™ automatically identifies bus lines and allows them to be tracked through the UUT.

QuickTrace™

```
 QuickTrace
 A10  A15
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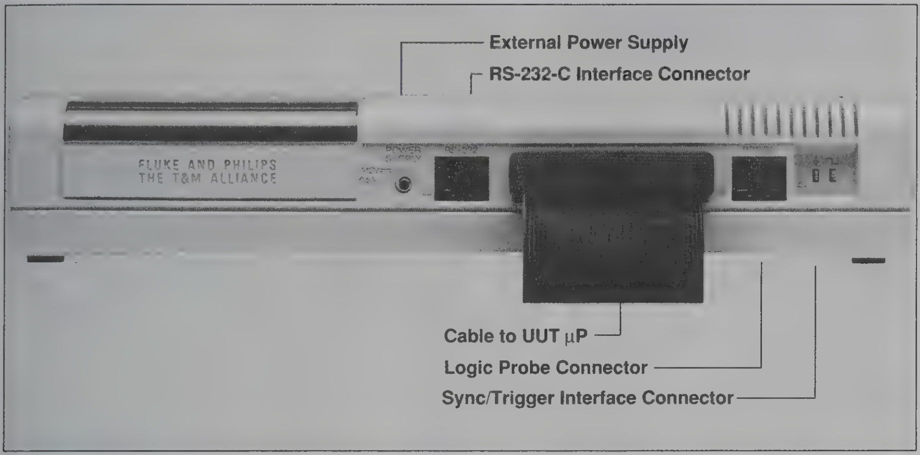
Shorted or stuck bus lines can be the most difficult faults to find. The 90 Series offers several tests to help isolate those faults. One of the most powerful is QuickTrace.™ Using the logic probe, circuit nodes are automatically identified. When recognized, the circuit node's name is displayed, and the probe light changes from red to green. In addition to immediate identification, any address, data, or control lines shorted together are also reported.

Real Time Testing

While performing most tests, the 90 Series "cycle steals" and drives the UUT's address, data, and control busses. This unique and proprietary technique allows testing, without disrupting normal UUT operation. The UUT continues to run at full system speed and execute its normal operations. This "cycle stealing" technique allows memory or I/O address to be tested, examined or written to without disturbing UUT operation. Marginal components and intermittent failures can be easily isolated. The UUT can be mechanically or thermally stressed while performing normal operations at the same time the 90 Series is testing. Voltage sensitive components can be also isolated by testing while the UUT power supply voltage is varied.

Testing External Devices

The 90 Series comes with a logic probe and SYNC/Trigger interface to aid in diagnosing problems in circuits outside the UUT's bus and memory. This SYNC/Trigger interface enhances oscilloscopes for troubleshooting digital problems by synchronizing it to valid UUT bus states. Only stable bus states are recognized, eliminating "garbage" due to triggering during non-valid bus conditions. When no tests are being executed, both the logic probe and external trigger are synchronized to the "data valid" state of the UUT's bus. When the 90 Series is performing a test, both the probe and External SYNC/Trigger interface are synchronized to the test performed by the 90 Series, allowing more detailed examination of the forced event.


External Power Supply
RS-232-C Interface Connector
FLUKE AND PHILIPS THE T&M ALLIANCE
Cable to UUT μP
Logic Probe Connector
Sync/Trigger Interface Connector

Advanced Troubleshooting Support

The 90 Series also has an RS-232 interface for remote operation and control. When operated remotely, all commands and operations available at the front panel are available via the RS-232 interface. Predefined tests sequences for automated fault isolation can be implemented. Additional diagnostic features are also present.

Breakpoint, Framepoint, and External Trigger

The 90 Series can be configured over the remote interface to execute a trap on preselected UUT events. Unusual or infrequent events are easily isolated for added fault finding power.

These traps trigger whenever the selected UUT event (memory examine, memory write, I/O examine, I/O write, interrupt acknowledge; or op-code fetch) occurs. They can be qualified by requiring a specified address or data bus value, and/or by requiring the probe to be in a given state. These traps can be used to; 1) Halt the UUT's microprocessor (Breakpoint) and display address and data information; 2) take a snapshot of the address and data busses (Framepoint) allowing the UUT to continue to run or; 3) generate a pulse at the SYNC/Trigger inteface (External Trigger).

Memory Upload and Download

The contents of UUT ROM and RAM can be uploaded and RAM contents can be downloaded via the remote interface. ROM contents can be uploaded and reverse assembled to produce software listings that might not otherwise be available.

QuickTools™ Software

QuickTools™ software makes remote operation of the Fluke 90 Series as easy as using the tester's front panel, and allows for interaction with the 90 Series' remote functions. QuickTools software provides an easy means of establishing remote control of the 90 Series with an IBM PC® or compatible to save, edit, and execute a series of test commands and to store and print the test results.

Ease of programming and operation are supported by menus, help screens and single keystroke command prompting. The software helps perform user-definable actions such as branches, calls and pauses within a test procedure. QuickTools software also allows for online operator instructions and messages. These can be combined with preprogrammed functions such as probe and QuickTrace applications.

In addition, test actions can be taken on the remote "breakpoint" and "framepoint" functions, permitting detailed monitoring and analysis of both field equipment and installed systems.

QuickTools software also supports the uploading and downloading of memory in Intel and Motorola hex format, and you can enable the external trigger for various applications. The RS-232 cable, provided with the unit, offers quick system connection.

Specifications

Microprocessors Supported: 8085, 6809E, 6809, Z80
Functions Supported: Power Supply Test; Clock Test; Control Line Test
Bus Tests: Shorted Address, Data or Control Lines; Stuck Address, Data or Control Lines
Ramp Test
Shift Test
Memory Tests: Test Memory; Checksum Memory; Examine Memory; Verify Memory; Write Memory; Memory Soak Test
I/O Tests: Examine I/O Port; I/O Verify Test; Write I/O Port
RS-232 Port Configuration Command
Probe Tests: QuickTrace™; Probe Address Lines; Probe Data Lines; Probe Control Lines
Break-Point, Frame-Point and External Trigger Commands: General Address Qualifiers; General Data Qualifiers; General Probe State Qualifiers; General Loop Count Qualifiers; CPU Function Qualifiers; Memory Read/Write CPU Function Qualifiers; I/O Read/Write CPU Function Qualifiers; Opcode Fetch CPU Function Qualifier; Interrupt Acknowledge CPU Function Qualifier
Memory Fill Command
Up-Load Memory Command
Down-Load Memory Command

RS-232-C Interface: Interconnect cable with DB-25 socket connector included. Uses XON/XOFF Protocol

Operating Conditions
Timing: Up to 20 MHz
Voltage: From UUT: 4.8 VDC to 5.3 VDC: Ext. PS: (7 VDC to 12 VDC)
Power Consumption: Less than .75W
Relative Humidity: Up to 80% 0°C to 35°C; up to 70% 35°C to 50°C, non-condensing
Ambient Temperature: 0°C to 50°C
User Interface: A 2-line by 16-character LCD panel. 24-key keypad: 16-keys for hex digit entry; 8-function-specific keys
Size: 280 mm W x 152 mm D x 51 mm H (11 in W x 6 in D x 2 in H)
Weight: 1.0 kg (2 lb 3 oz)
Includes: User's manual, probe, RS-232 cable, application notes, 17-min video showing how to use Fluke 90

Ordering Information

Models	January 1989 prices
Fluke 90 Z80 μP Board Tester	$1595
Fluke 90 8085 μP Board Tester	1595
Fluke 90 6809/6809E μP Board Tester	1595
Fluke 90 S100 QuickTools Software	300

Option Compatibility

9005A, 9010A, 9020A Option Compatibility

Option	Description	9005A	9010A	9020A-001	9020A-002
9000A-*	Interface Pods (all)	•	•	•	•
9010A-001	RS-232 Interface	1	1	#	–
9000A-006	Asynchronous Signature Probe	1	1	1	1
9000A-010	Demonstration and Training Package	2	2	2	2
9000A-200	Kit for customizing Interface Pods	3	3	3	3
9000A-201	Clip-on Adapter for -8051 Pod	•	•	•	•
9000A-900	Transit Case	•	•	•	•
9000A-901/AC	PCB for Troubleshooting Classes	•	•	•	•
9000A-910	Utility Tape	–	•	–	–
9010A-920	Language Compiler for 1722A or 1720A	–	4	–	–
9010A-922	Language Compiler for Kay Pro	–	5	–	–
9010A-923	Language Compiler for IBM PC	–	5	–	–
9020A-925	Testwriter, PC Software	6	6	7	–
9000A-9711	Tape for Troubleshooting 8520As	•	•	–	–
9010A/GF	For Guided Fault Testing w/Option -925	1	1	–	–
Other Items					
Y8007	Package of Ten Minicassette Tapes	•	•	–	–

Notes: All options are customer-installable except where noted.

† Compatible option

** Option suffix identifies Interface Pod type*

# RS-232 capability included

1 Installed at Factory or, at extra charge later, order through Service Center

2 Requires 9000A-80286 Pod

3 Use only on 40-pin microprocessor adaptations

4 Option 9010A-001 is required. E Disk Option 1720A-001 is required for 1720A

5 Option 9010A-001 is required

6 Requires IBM PC with RS-232 Interface, 9010A, and 9010A/GF

7 Requires IBM PC with RS-232 Interface

9100 Series Option Compatibility

Option	Description	9100A;/SYS	9100A	9105A
9000A-*	Interface Pods (all)	•	•	•
9100A-003	Parallel I/O Module (four can be used)	#	•	•
9100A-004	Programmers' Station w/Monochrome Monitor	#	1	–
9100A-005	Programmers' Station w/o Monitor (for Color)	–	1	–
9105A-007	512K Memory Expansion	–	–	1
9105A-008	Real-Time Clock	–	–	1
9100A-009	Monochrome Monitor	2	1	1
9000A-010	Demonstration and Training Package	4	4	4
9100A-011	Color Video Card	–	1	1
9100A-012	2 M-Byte Memory Expansion	1	1	–
9100A-013	Keyboard	#	•	•
Other Items				
Y8091	Package of Ten 3.5-inch Floppy Disks	#	#	#
Y9100A-DCS	DIP CLIP Set (-14D through -40D)	#	•	•

Notes: All options are customer-installable except where noted.

† Compatible option

** Option suffix identifies Interface Pod type*

# One included

1 Installed at Factory or, at extra charge later, order through Service Center

2 Included as part of 9100A-004

Calibration Instruments

All electrical and electronic test and measurement instruments must be calibrated – when they are manufactured, and at regular intervals, to ensure accuracy and confidence in their measurements. Practically all instruments that measure voltage, current or resistance, can be calibrated with Fluke calibrators, standards, and auxiliary equipment.

Fluke is the leader in calibration equipment. This leadership applies to advancement in precision equipment and software and support services that greatly improves the productivity of calibration professionals. If you think it may be economical to calibrate your own voltmeters, ammeters, ohmmeters, multimeters, oscilloscopes, or other instruments of that kind, study Fluke's complete calibration solutions on the following pages.

Page 187 5700A

Page 187 5725A

Page 228 742A-1 & 742A-10k

Page 229 732A

Page 218 7457A

Page 193 5100B

Selection Charts 184
Calibration Instruments 187
Calibration Systems and Software 212
Standards Instruments 227

What is Calibration?

Calibration is a special, highly-refined process in which you compare an instruments performance with standards of known uncertainty to detect or correct any variation from required performance. In other words, it is a process verifying the operational integrity of instruments.

All electrical and electronic test and measurement instruments must be calibrated, both at the time of manufacture and at regular intervals during use, to assure the accuracy of and confidence in the measurements you make. You will also find that in many instances certification of calibration is a legal requirement.

Calibration provides two major benefits. First, it allows you to use your instruments with confidence by minimizing the uncertainties associated with your measurements. Second, it fulfills the requirements for "traceability" to national standards demanded so frequently today.

Fluke is the leader in DC and low frequency calibration. Fluke provides a broad range of products, from calibration instrumens, to automated calibration systems, and the standards required to maintain them. If you calibrate voltmeters, ohmmeters, ammeters, multimeters, oscilloscopes, or other electronic test and measurement instruments, Fluke has the calibration solutions to match your workload.

The range of Fluke products includes high-accuracy single-function calibrators for calibrating your high end voltmeters. Fluke also provides multifunction manual and bus-controllable calibrators that can economically calibrate the bulk of your low- and mid-accuracy workload. These include a full line of accessories and auxiliary products.

Fluke also offers the next logical step in calibration, automated systems that will increase your productivity and repeatability, while easing your documentation process. You can start the automation process without replacing your existing instrument inventory. Instruments you purchase now can be integrated into systems as your workload expands. And what you need to add later will work with what you have now. Fluke provides the calibration software to meet your calibration workload.

Fluke's commitment to the calibration market includes the support services you require. Applications support, training, traceability programs, maintenance, repair, calibration services, and module exchange programs you expect are all available from Fluke.

Study the Fluke calibration solutions on the following pages. If you need assistance, contact your Fluke Account Manager or call Fluke (toll free in the U.S.) at 800-426-0361.

Automated Calibration Systems Based on 7411 Calibration Software

Model	Oscilloscope Calibration	Multimeter Calibration	Measurement Capability	Page
7457A	—	Yes	—	220
7451A	—	Yes	Yes	222
7409B	Yes	—	Yes	224
A123	Yes	Yes	Yes	226

AC/DC Transfer Standards

Model	Volts	Current	AC/DC Difference	Frequency Range	Page
540B	To 1000V	With A40 A40A	0.01%	5 Hz to 1 MHz	234
A55	0.5	–	0.05% to 0.5%	1 MHz to 50 MHz	236
A40	–	10 mA to 5A	0.02% with 540B	5 Hz to 100 kHz	235
A40A	–	10 A to 20A	0.03% with 540B	5 Hz to 50 kHz	235

Calibrators

Model	Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Resistance	Wide-band Voltage	Basic Uncertainty	IEEE-488	Page
5700A	To 1100V	To 1100V	To 2.2A	To 2.2A	1.0Ω to 100 MΩ	Option	5 ppm	Yes	187
5100B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	40 ppm	Option	193
5101B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	50 ppm	Option	193
5440B	To 1100V	–	–	–	–	–	3 ppm	Yes	197
5442A	To 1100V	–	–	–	–	–	4 ppm	Yes	197
5200A	–	To 120V	–	–	–	–	200 ppm	Option	199
5450A	–	–	–	–	1.0Ω to 100 MΩ	–	8 ppm	Yes	202
335A	To 1110V	–	–	–	–	–	20 ppm	No	208
335D	To 1110V	–	–	–	–	–	10 ppm	No	208
343A	To 1110V	–	–	–	–	–	20 ppm	No	209
515A	To 100V	To 100V	–	–	10Ω to 100 MΩ	–	30 ppm	No	210

Amplifiers

Model	Output Range	Compatible Calibrator	Gain Transcond.	Page
5725A	1100V 1 to 11A AC/DC	5700A	–	187
5205A	1200V rms 1600V dc	5100B 5101B 5102B 5200A 5440B	100	203
5215A	1200V rms	5100B 5101B 5102B 5200A	100	205
5220A	1 to 20A	5100B 5101B 5102B 5440B	1A/V	207

Reference Standards

Model	Amplitude Stability	Direct Voltage	Alternating Voltage	Resistance	Frequencies	DVMP*	Page
510A	±0.005 % in 30 Days	–	10V rms	–	50 Hz to 100 kHz	No	237
731B	10 ppm	10V 1V 1.018V ΔV	–	–	–	No	238
732A	0.5 ppm	10V 1V 1.018V	–	–	–	Yes	229
742A	5 ppm	–	–	1Ω and 10 kΩ	–	–	228

**Direct Voltage Maintenance Program. See page 231.*

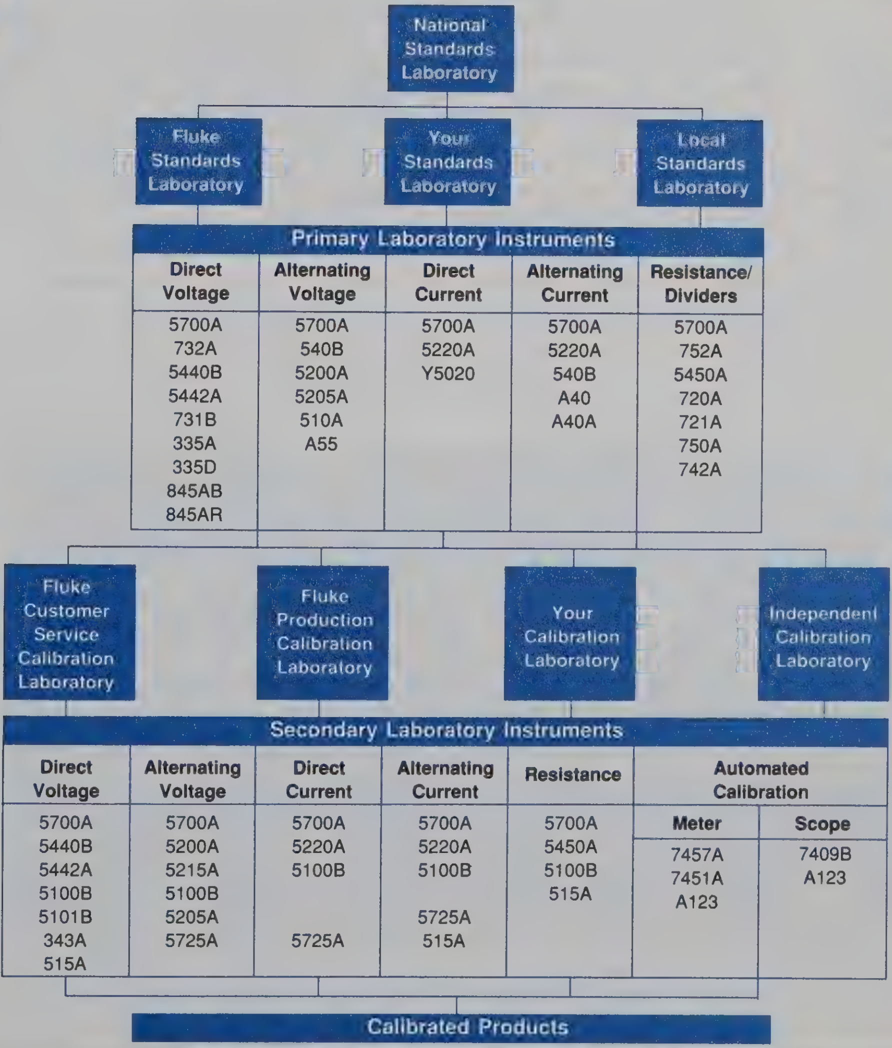
Dividers and Standards Equipment

Model	Basic Uncertainty	Stability	Input Range	Page
752A	0.2 ppm - 10:1 0.5 ppm - 100:1	–	1100V	233
Y5020	±0.01%	0.002% in 6 months	0 to 20A	211
720A	0.1 ppm	1.0 ppm/year	0 to 1100V	239
721A	–	–	4000:1 Ratio	238
750A	10 ppm	10 ppm/year	1.1 to 1100V	239
845AB	2%	0.15 µV/hr	1.0 µV to 1000V	240
845AR	3%	0.15 µV/hr	1.0 µV to 1000V	240

Using the Product/Applications Guide

The traceability chart shows you how Fluke calibration products cover your Calibration Lab and Standards Lab workload. This chart will help you select the instrumentation you need in your facility.

Find the position of your lab on the chart. Then refer to the box below for the appropriate products. Each product is fully described in the following pages. Your local Fluke Account Manager will be glad to assist you in matching Fluke instruments and systems to your requirements.


National Standards Laboratory
Fluke Standards Laboratory
Your Standards Laboratory
Local Standards Laboratory
Primary Laboratory Instruments
Fluke Customer Service Calibration Laboratory
Fluke Production Calibration Laboratory
Your Calibration Laboratory
Independent Calibration Laboratory
Secondary Laboratory Instruments
Calibrated Products

Primary Laboratory Instruments

Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Resistance/ Dividers
5700A	5700A	5700A	5700A	5700A
732A	540B	5220A	5220A	752A
5440B	5200A	Y5020	540B	5450A
5442A	5205A		A40	720A
731B	510A		A40A	721A
335A	A55			750A
335D				742A
845AB				
845AR				

Secondary Laboratory Instruments

Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Resistance	Automated Calibration	
					Meter	Scope
5700A	5700A	5700A	5700A	5700A	7457A	7409B
5440B	5200A	5220A	5220A	5450A	7451A	A123
5442A	5215A	5100B	5100B	5100B	A123	
5100B	5100B			515A		
5101B	5205A		5725A			
343A	5725A	5725A	515A			
515A						

Cost-Effective Solutions for the Cal Lab Workload

While a calibrator's parts per million (ppm) specifications are important, focusing on specifications alone is not the best approach to selecting a calibration instrument. Other factors such as reliability, ease of use, expandability, service, and manufacturer service and responsiveness are equally as important as specifications. You need to consider the total cost of ownership.

Satisfying your calibration needs means far more than just buying some calibration hardware. Of course you need to look at the specifications, but make sure you are evaluating performance that fits your needs and not just paper promises.

The real challenge is how to get the most cost-effective workload coverage. Consider your population of instruments. Will you be calibrating ATE systems or handheld DMMs? How high is your volume?

To obtain sufficient workload coverage in the past, many different instruments were required to handle a single calibration task. Single instruments are now capable of multiple tasks. For example, when Fluke introduced the 5100 Series, it replaced the need for six different instruments and was dubbed the "cal lab in a box." With technology advances such as these, the expense of equipping a cal lab is decreasing. A new offering, the 5700A, provides still higher accuracy while maintaining compability with the 5100 Series.

You also need to keep the future in mind. Will you want to automate your calibration process at a later date? If so, sonsider calibration instruments that can be integrated into automated calibration systems. (See page XXX for a description of how Fluke calibration instruments can be expanded into automated systems.) Expandability is an important factor in protecting your instrumentation investment.

A crucial aspect of achieving the best workload coverage is determining the level of accuracy required to calibrate instruments in your workload. For the most cost effective investment, concentrate your on instruments covering the greatest portion of your workload.

Selection Guide

Model	Multimeter Calibration	Direct Voltage Calibration	Alternating Voltage Calibration	Direct Current Calibration	Alternating Current Calibration	Resistance Calibration	Compatible Amplifiers
5700A	•	•	•	•	•	•	5725A, 5205A, 5215A, 5220A
5100B	•	•	•	•	•	•	5205A, 5215A, 5220A
5101B	•	•	•	•	•	•	5205A, 5215A, 5220A
5440B		•					5205A, 5220A
5442A		•					5205A, 5220A
5200A			•				5205A, 5215A
5450A						•	
335A		•					
335D		•					
343A		•					
515A	•	•	•			•	

For Further Information

To help you learn more about calibration and various related subjects, Fluke offers a wide variety of literature. This catalog lists all the technical literature available. Some specific terms of interest are listed below.

Traceability Chart: Derivation of Electrical Units

This full-color poster traces the derivation of electrical units from the basic world standards to the level of instrumentation in your calibration lab. It will be valuable for teaching new technicians derivation of units.

Technical Papers on Newest Technology

A number of technical papers presented at recent metrology conferences around the world are available, describing the latest advances in the field. Ask your Account Manager for a complete list of those available.

Calibration: Philosophy in Practice

This book, a "cal lab classic," describes various aspects of lab operation, types of instrumentation, and the theories underlying them.

Information is included on basic units and standards of measurement, and how traceability is maintained to guarantee the integrity of your measurements.

5700A

GPIB
IEEE-488

NEW

5700A

5700A Calibrator

- Covers the complete DMM calibration workload
- Precision performance that is easy to use
- Simplified support with Artifact Calibration
- Compatible to protect your investment

Wide Workload Coverage

The Fluke 5700A is designed to cover the widest portion of today's calibration workload - a wide variety of DMMs from all manufacturers. It delivers direct voltage to 1100V and alternating voltage from 220 µV to 1100V at frequencies from 10 Hz to 1.2 MHz. Cardinal point resistances range from 1Ω to 100 MΩ in x1 and x1.9 decades, including a short. Direct and alternating current are provided to 2.2A, and frequencies for alternating current range from 10 Hz to 10 kHz.

Only one option is offered for the 5700A, Wideband Voltage (-03). It provides flat, low-noise alternating voltage output from 10 Hz to 30 MHz to extend workload coverage to include RF voltmeters. Output may be selected in volts or dBm referenced to 50Ω.

The companion 5725A Amplifier extends the 5700A's workload coverage still further. It increases maximum direct and alternating current to 11A for calibrating the high current ranges of popular low-cost and hand-held DMMs. And it extends the calibrator's alternating volt-hertz product to 1100V at 30 kHz and 750V at 100 kHz to cover the calibration requirements of high-accuracy bench and system meters.

The 5700A is designed to be taken to the workload. In manufacturing applications, test instruments may be calibrated on-site, minimizing production line downtime due to calibration recall.

Low Cost of Ownership

The original purchase price is not the most significant cost associated with owning a high accuracy calibrator. Once the instrument is on the job, a wide range of calibration, maintenance, repair and training requirements increase its cost of ownership beyond the original purchase price many times over.

The 5700A Calibrator was designed to keep those traditional ownership costs down. Its powerful features are easy to use. Advanced internal metrology dramatically reduces support requirements while increasing your confidence in the instrument's performance. And its rugged, modular design increases reliability and makes problems easy to find and repair when they occur.

Simplified Calibration Support

Only three Artifact Standards, a 10V dc reference and 1Ω and 10 kΩ resistance references, are required to calibrate all 5700A ranges and functions to full specifications. The process, running under the control of the calibrator, takes about one hour. Instructions are displayed on the front panel in plain English to prompt the operator when to make various connections and inputs. For added confidence, Fluke recommends that a full verification of the 5700A be performed every two years or as required by your established procedures.

The 5700A does not need to be recalled to the standards laboratory for calibration. Due to its unique, environmentally tolerant design, the 5700A may be calibrated wherever it is used, at any temperature between 15°C and 35°C. Full performance is available for ±5°C of that temperature.

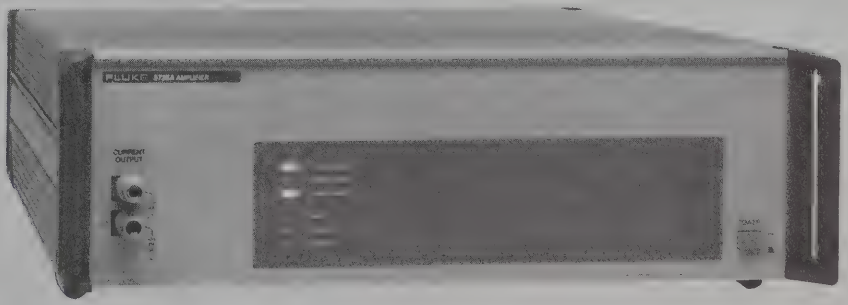
Complete Confidence

Between Artifact Calibrations, the 5700A's performance may be checked against its internal standards. Without adjusting the instrument, an automated procedure is available to check each range and function against internal check standards to increase your confidence that it is within performance tolerances. Should any range be shown to be out of specification, the operator is alerted. All results of this Cal Check process can be printed via RS-232 port. This data can be used to develop control charts to predict the long-term performance of the calibrator.

High Performance That's Easy to Use

In the past, calibration of precision DMMs required a host of complex, manually operated instruments and standards.

The 5700A combines the functions of these instruments to dramatically simplify DMM calibration. Values are entered on the simple numeric keyboard and displayed on the front



5725A

panel. The command is confirmed with the ENTER key. To verify the reading of the UUT, the operator simply adjusts the output knob and the error is displayed directly in ppm or %. Output values can be selected for editing using the arrow keys. Using the OFFSET and SCALE keys, the 5700A compensates for meter zero offset and scale errors and directly displays linearity errors at any scale level. The x10 and ÷10 keys simplify work on meters requiring calibration levels in even decade steps. Just multiply or divide any output value by pressing the corresponding key.

To protect the operator and UTT, limits on maximum output can be preset. For additional operator protection, the 5700A resets to standby mode when output is increased to more than 22V.

Compatibility

The 5700A is designed to protect your investment in existing Fluke instruments and procedures. For example, a Fluke 5205A or 5215A voltage amplifier, and a Fluke 5220A transconductance amplifier may be connected directly to the 5700A through dedicated ports. In automated systems, the 5700A may be configured to emulate a 5100B so that existing procedures can be run with minimal modification.

Designed for Reliability

Another important factor in keeping instrument cost of ownership low is product reliability. Throughout its design and manufacture, the 5700A has been engineered to be the most reliable instrument of its type. Statistical process control techniques assure that quality is maintained, from component test through final assembly. Every 5700A is subjected to more than 2g of random vibration to prevent subtle imperfections from causing failures later on. A stiff chassis permits the 5700A to be moved with minimal risk of damage. Internal DIN connectors seal out potential environmental problems while keeping circuit boards firmly connected. Internal diagnostics exercise both digital and analog functions and can isolate problems to the board level, so repair often requires nothing more than the replacement of a plug-in module.

Specification Summary*

To simplify evaluation of how the 5700A covers your calibration workload, use the 5700A absolute uncertainty specifications.

Specifications

DC Voltage

Range	Resolution	Absolute Uncertainty ±5°C from calibration temperature			
		24 Hours	90 Days	180 Days	1 Year
		±(ppm output + μV)			
220 mV	10 nV	6.5 + .75	7 + .75	8 + .75	9 + .8
2.2V	100 nV	3.5 + 1.2	6 + 1.2	7 + 1.2	8 + 1.2
11V	1 μV	3.5 + 3	5 + 4	7 + 4	8 + 4
22V	1 μV	3.5 + 6	5 + 8	7 + 8	8 + 8
220V	10 μV	5 + 100	6 + 100	8 + 100	9 + 100
1100V	100 μV	7 + 600	8 + 600	10 + 600	11 + 600

Resistance

Nominal Value	Absolute Uncertainty of Characterized Value ±5°C from calibration temperature			
	24 Hours	90 Days	180 Days	1 Year
Ω	±ppm			
0	50 μΩ	50 μΩ	50 μΩ	50 μΩ
1	85	95	100	110
1.9	85	95	100	110
10	26	28	30	33
19	24	26	28	31
100	15	17	18	20
190	15	17	18	20
1k	11	12	13	15
1.9k	11	12	13	15
10k	9	11	12	14
19k	9	11	12	14
100k	11	13	14	16
190k	11	13	14	16
1M	16	18	20	23
1.9M	17	19	21	24
10M	33	37	40	46
19M	43	47	50	55
100M	110	120	125	130

Absolute Uncertainty includes stability, temperature coefficient, linearity, line and load regulation, and the traceability of external standards. You do not need to add anything to determine the ratios between 5700A uncertainties and the uncertainties of your calibration workload.

**Complete 5700A and 5725 specifications are available. Ask for Fluke document A0296.*

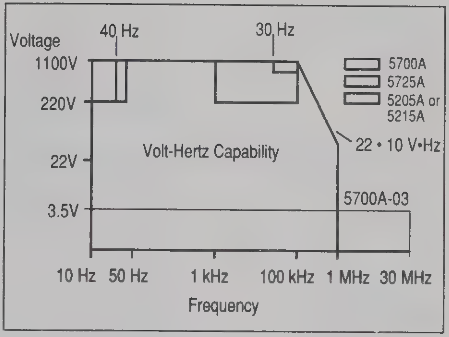
Resistance

Seventeen passive resistance values are supplied in x1.0 and x1.9 mutiples, plus a short to allow complete resistance calibration without moving test leads. Actual values assigned during calibration are displayed and used as reference points for error calculations.

For calibration of highter accuracy meters, 4-wire output connection is provided, with absolute uncertainties as shown in the table. Active 2-wire compensation is available for calibration of less accurate ohmmeters with 2-wire inputs. This feature substantially eliminates errors due to test lead resistance, and may be selected for resistance values up to 19 kΩ.

AC Voltage

Range	Resolution	Frequency	Absolute Uncertainty ± 5°C from calibration temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + μV)			
2.2 mV	1 nV	10-20	500 + 5	550 + 5	600 + 5	600 + 5
		20-40	200 + 5	220 + 5	230 + 5	240 + 5
		40-20k	100 + 5	110 + 5	120 + 5	120 + 5
		20k-50k	340 + 5	370 + 5	390 + 5	410 + 5
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30
22 mV	10 nV	10-20	500 + 6	550 + 6	600 + 6	600 + 6
		20-40	200 + 6	220 + 6	230 + 6	240 + 6
		40-20k	100 + 6	110 + 6	120 + 6	120 + 6
		20k-50k	340 + 6	370 + 6	390 + 6	410 + 6
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30
220 mV	100 nV	10-20	500 + 16	550 + 16	600 + 16	600 + 16
		20-40	200 + 10	220 + 10	230 + 10	240 + 10
		40-20k	95 + 10	100 + 10	110 + 10	110 + 10
		20k-50k	300 + 10	330 + 10	350 + 10	360 + 10
		50k-100k	750 + 30	800 + 30	850 + 30	900 + 30
		100k-300k	940 + 30	.1% + 30	.11% + 30	.11% + 30
		300k-500k	.15% + 40	.17% + 40	.17% + 40	.18% + 40
		500k-1M	.30% + 100	.33% + 100	.35% + 100	.36% + 100
2.2V	1 μV	10-20	500 + 100	550 + 100	600 + 100	600 + 100
		20-40	150 + 30	170 + 30	170 + 30	180 + 30
		40-20k	70 + 7	75 + 7	80 + 7	85 + 7
		20k-50k	120 + 20	130 + 20	140 + 20	140 + 20
		50k-100k	230 + 80	250 + 80	270 + 80	280 + 80
		100k-300k	400 + 150	440 + 150	470 + 150	480 + 150
		300k-500k	.10% + 400	.11% + 400	.12% + 400	.12% + 400
		500k-1M	.20% + 1 mV	.22% + 1 mV	.23% + 1 mV	.24% + 1 mV
22V	10 μV	10-20	500 + 1 mV	550 + 1 mV	600 + 1 mV	600 + 1 mV
		20-40	150 + 300	170 + 300	170 + 300	180 + 300
		40-20k	70 + 70	75 + 70	80 + 70	85 + 70
		20k-50k	120 + 200	130 + 200	140 + 200	140 + 200
		50k-100k	230 + 400	250 + 400	270 + 400	280 + 400
		100k-300k	500 + 1.7 mV	550 + 1.7 mV	550 + 1.7 mV	600 + 1.7 mV
		300k-500k	.12% + 5 mV	.13% + 5 mV	.13% + 5 mV	.14% + 5 mV
		500k-1M	.26% + 9 mV	.28% + 9 mV	.29% + 9 mV	.30% + 9 mV
			±(ppm output + mV)			
220V	100 μV	10-20	500 + 10	550 + 10	600 + 10	600 + 10
		20-40	150 + 3	170 + 3	170 + 3	180 + 3
		40-20k	75 + 1	80 + 1	85 + 1	90 + 1
		20k-50k	200 + 4	220 + 4	240 + 4	250 + 4
		50k-100k	500 + 10	550 + 10	600 + 10	600 + 10
		100k-300k	.15% + 110	.15% + 110	.16% + 110	.16% + 110
		300k-500k	.50% + 110	.52% + 110	.53% + 110	.54% + 110
		500k-1M	1.20% + 220	1.25% + 220	1.25% + 220	1.30% + 220
1100V	1 mV	50-1k	75 + 4	80 + 4	85 + 4	90 + 4



AC Voltage, 5725A Amplifier

Range	Resolution	Frequency	Absolute Uncertainty ± 5°C from calibration temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + mV)			
1100V	1 mV	40-1k	75 + 4	80 + 4	85 + 4	90 + 4
		1k-20k	105 + 6	125 + 6	135 + 6	165 + 6
		20k-30k	230 + 11	360 + 11	440 + 11	600 + 11
750V		30k-50k	230 + 11	360 + 11	440 + 11	600 + 11
		50k-100k	600 + 45	.13% + 45	.16% + 45	.23% + 45

5700A

DC Current

Range	Resolution	Absolute Uncertainty ±5°C from calibration temperature			
		24 Hours	90 Days	180 Days	1 Year
	nA	±(ppm output + nA)			
220 µA	.1	45 + 10	50 + 10	55 + 10	60 + 10
2.2 mA	1	45 + 10	50 + 10	55 + 10	60 + 10
22 mA	10	45 + 100	50 + 100	55 + 100	60 + 100
	µA	±(ppm output + µA)			
220 mA	.1	55 + 1	60 + 1	65 + 1	70 + 1
2.2A	1	80 + 30	85 + 30	90 + 30	95 + 30
5725A Amplifier:					
11A	10	380 + 470	385 + 480	390 + 480	400 + 480

AC Current

Range	Resolution	Frequency	Absolute Uncertainty ± 5°C from calibration temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + nA)			
220 µA	1 nA	10-20	650 + 30	700 + 30	750 + 30	800 + 30
		20-40	350 + 25	380 + 25	410 + 25	420 + 25
		40-1k	120 + 20	140 + 20	150 + 20	160 + 20
		1k-5k	650 + 1 µA	750 + 1 µA	800 + 1 µA	850 + 1 µA
		5k-10k	.40% + 4 µA	.44% + 4 µA	.46% + 4 µA	.48% + 4 µA
2.2 mA	10 nA	10-20	650 + 50	700 + 50	750 + 50	800 + 50
		20-40	350 + 40	380 + 40	410 + 40	420 + 40
		40-1k	120 + 40	140 + 40	150 + 40	160 + 40
		1k-5k	650 + 2 µA	750 + 2 µA	800 + 2 µA	850 + 2 µA
		5k-10k	.4% + 4 µA	.44% + 4 µA	.46% + 4 µA	.48% + 4 µA
22 mA	100 nA	10-20	650 + 500	700 + 500	750 + 500	800 + 500
		20-40	350 + 400	380 + 400	410 + 400	420 + 400
		40-1k	120 + 400	140 + 400	150 + 400	160 + 400
		1k-5k	650 + 10 µA	750 + 10 µA	800 + 10 µA	850 + 10 µA
		5k-10k	.4% + 20 µA	.44% + 20 µA	.46% + 20 µA	.48% + 20 µA
		Hz	+(ppm output + µA)			
220 mA	1 µA	10-20	650 + 5	700 + 5	750 + 5	800 + 5
		20-40	350 + 4	380 + 4	410 + 4	420 + 4
		40-1k	300 + 4	330 + 4	350 + 4	360 + 4
		1k-5k	700 + 50	750 + 50	800 + 50	850 + 50
		5k-10k	.4% + 100	.44% + 100	.46% + 100	.48% + 100
2.2A	10 µA	40-1k	600 + 40	650 + 40	700 + 40	750 + 40
		1k-5k	700 + 100	750 + 100	800 + 100	850 + 100
		5k-10k	.80% + 200	.90% + 200	.95% + 200	1.0% + 200
5725A Amplifier:						
11A	100 µA	40-1k	370 + 170	400 + 170	440 + 170	460 + 170
		1k-5k	800 + 380	850 + 380	900 + 380	950 + 380
		5k-10k	.3% + 750	.33% + 750	.35% + 750	.36% + 750

Current

The 5700A supplies direct alternating current to 2.2A, extended to 11A with the 5725A Amplifier or to 20A with the 5220A Transconductance Amplifier. 5700A current output is available on front or rear voltage output terminals. For convenience in calibrating meters with separate current terminals, 5700A outputs may also be directed either to an auxiliary front panel current terminal or to 5725A front or rear terminals. Thsi allows automated meter calibration without moving test leads.

For system applications, a rear panel current guard provides a voltage follower output for guarding low level current through longer system cables.

Wideband AC Voltage (Option -03)

Specifications apply to the end of the cable and 50Ω termination used for calibration:

Range		Resolution	Absolute Uncertainty ±5°C from calibration temperature 30 Hz-500 kHz			
Volts	dBm		24 Hours	90 Days	180 Days	1 Year
			±(% output + µV)			
1.1 mV	-46	10 nV	.2 + .4	.4 + .4	.6 + .4	.8 + 2
3 mV	-37	10 nV	.2 + 1	.35 + 1	.5 + 1	.7 + 3
11 mV	-26	100 nV	.2 + 4	.35 + 4	.5 + 4	.7 + 8
33 mV	-17	100 nV	.2 + 10	.3 + 10	.45 + 10	.6 + 16
110 mV	-6.2	1 µV	.2 + 40	.3 + 40	.45 + 40	.6 + 40
330 mV	+3.4	1 µV	.2 + 100	.25 + 100	.35 + 100	.5 + 100
1.1V	+14	10 µV	.2 + 400	.25 + 400	.35 + 400	.5 + 400
3.5V	+24	10 µV	.15 + 500	.2 + 500	.3 + 500	.4 + 500

Frequency	Frequency Resolution	Amplitude Flatness, 1 kHz Reference Voltage Range		
		1.1 mV	3 mV	>3 mV
Hz	Hz	±%		
10-30	.01	.3	.3	.3
30-120	.01	.1	.1	.1
120-1.2k	.1	.1	.1	.1
1.2k-12k	1	.1	.1	.1
12k-120k	10	.1	.1	.1
120k-1.2M	100	.2 + 3 µV	.1	.1
1.2M-2M	100k	.2 + 3 µV	.1	.1
2M-10M	100k	.2 + 3 µV	.1	.1
10M-20M	1M	.2 + 3 µV	.3	.2
20M-30M	1M	1.5 + 15 µV	1.5	1

Additional Operating Information:
dBm reference = 50Ω
Range boundaries are at voltage points, dBm levels are approximate.

$\text{dBm} = 10 \log \left(\frac{\text{Power}}{1\ \text{mW}} \right),$

for 50Ω: 0 dBm = 1 mW across 50Ω = 0.22361V
Minimum Output: 300 µV (-57 dBm)
Frequency Uncertainty: ±0.01%
Overload Protection: A short circuit on the wideband output will not result in damage. After settling time, normal operation is restored upon removal.

General Specifications

Warm-up Time: 2x the time since last warmed up, to a maximum of 30 minutes.
System Installation: Rear output configuration and rackmount kit available.
Standard Interfaces: IEEE-488, RS-232, 5725A, 5205A or 5215A, 5220A, phase lock in (BNC), phase reference out (BNC).
Temperature Performance: Operating: 0°C to 50°C. Calibration: 15°C to 35°C. Storage: -40°C to 75°C.
Relative Humidity: Operating: <90% to 30°C, <70% to 40°C, <40% to 50°C. Storage <95%, non-condensing
Safety: Designed to comply with UL 1244 (1987); IEC 348-1978I IEC 66E (CO) 4; CSA 556B.
Guard Isolation: 20 volts
EMI/RFI: Designed to comply with FCC Rules Part 15, Subpart J, Class B; VDE 0871, Class B.
Reliability: MIL-T-28800D, para. 3.13.3
Line Power: 47 to 63 Hz; ±10% allowed about selectable nominal line voltage: 100V, 110V, 115V, 120V, 200V, 220V, 230V, 240V. Maximum power: 5700A, 300VA; 5725A, 750VA.
Size:
5700A: Height 17.8 cm (7 in), standard rack increment, plus 1.5 cm (o.6in) for feet; Width 43.2 cm (17 in), standard rack width; Depth 63.0 cm (24.8), overall; 57.8 cm (22.7 in), rack depth. 5725A: Height 13.3 cm *5.25 in); Width and depth same as 5700A. Both units project 5.1 cm (2 in) from rack front
Weight: 5700A: 27kg (62 lbs); 5725A: 32kg (70 lbs)

All ranges and functions of the 5700A, 5725A and Wideband Voltage option may be calibrated using just three Artifact Standards.

Calibration Requirements

Calibrating the 5700A to full specified absolute uncertainty requires only the following standards:

Fluke Standard	Traceable Quantity	Nominal Value	Uncertainty*
732A	Voltage	10V	±1.5 ppm
742A-1	Resistance	1Ω	±10 ppm
742A-10k	Resistance	10 kΩ	±4 ppm

**Relative to national standards*

The 5700A's simple, built-in, self-prompting calibration procedure is designed to use the portable Fluke standards to completely calibrated all of it functions.

Calibration may be done at any temperature from 15°C to 35°C without change to any specification except for resistance. Resistance specifications are modified by a small temperature coefficient when the 5700A is calibrated below 19°C or above 24°C.

You may use standards with different uncertainties than given in the table at left. Absolute uncertainty must then be modified by the algebraic difference between the uncertainty of the standard used and that in the table. For example if the dc voltage standard has an uncertainty of ±2.5 ppm, 5700A DC Voltage absolute uncertainty specifications will all be increased by ±1 ppm. Note that dc and ac current specifications include the uncertainties of both the dc voltage and resistance standards that are used.

Ordering Information

Model

January 1989 prices

5700A Calibrator	$19,950
5700A-01 Calibrator, Rear Output Option*	0
5725A Amplifier	7950
5725A-01 Amplifier, Rear Output Option*	0

**Factory installed only*

Option

5700A-03 Wideband AC Voltage	3995

Accessories (Also see page 485)

5440A-7002 Low Thermal Cable Set	350
732A DC Voltage Reference Standard	3800
742A-1 1Ω Resistance Standard	795
742A-10k 10 kΩ Resistance Standard	695
Y5701 Cable for 5205A or 5215A	250
Y5702 Cable for 5220A	250
Y5737 Rack Mount Kit with 24" slides for 5700A*	110
Y5735 Rack Mount Kit with 24" slides for 5725A*	110
Y8021 Shielded IEEE-488 Cable, 1 meter	130
Y8022 Shielded IEEE-488 Cable, 2 meters	145
Y8023 Shielded IEEE-488 Cable, 4 meters	155

**Note: These rack slides allow for side ventilation.*

Service and Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-5700A Repair (w/calibration)	227
SC2-5700A Cal	95
SC1-5725A Repair (w/calibration)	110
SC2-5725A Cal	63

5100B Series

GPIB
IEEE-488

RS-232

New and Improved

5100B

5100B Series Calibrators

- New and improved version of the world's most popular multifunction calibrator
- Cost-effective multimeter calibration to 4½ digits
- Five functions: Direct or alternating voltage or current plus resistance
- New front panel, new output terminals, and updated control panel
- Modern production methods offer superior quality
- Unique cassette tape drive option available for storing procedures
- Compatible with Fluke 7411C and 7411PC based systems, 5700A Calibrator, 5205A/5215A Power Amplifiers, and 5220A Transconductance Amplifier

The 5100B Series Calibrators are the world's leading calibrators for analog and digital multimeters to 4½ digits. Dependability, five-function versatility and cost effectiveness have made the 5100B Series Calibrators basic equipment for nearly every calibration laboratory.

Now these calibrators offer even more value. DC voltage uncertainty is 40 ppm; Basic AC uncertainty is 350 ppm. The front panel includes new, high-voltage safety terminals together with control grouping optimized for user friendliness. Quality and reliability are also enhanced with modern manufacturing methods including statistical process control (SPC).

The versatility of the 5100B Series Calibrators is unmatched at any price. They are compatible with the popular Fluke 7411C and 7411PC based Calibration Systems, the Navy's MECCA Systems and the new Fluke 5700A Multifunction Calibrator. Enhanced capability is also available with the 10 MHz Wideband Option and the capability to directly drive the Fluke 5220A 20A Transconductance Amplifier and the 5205A or 5215A High Voltage Amplifier.

5100B Series Increases Throughput

A large share of the workload of meter calibration laboratories and production lines consists of analog and digital meters with 4½ digit or less resolution. There are hundreds of different meters in this category representing different manufacturers, with no standard format for meter specifications. Even meters from the same manufacturer are often specified differently. This creates a real problem for any cal lab manager.

Until Fluke introduced the 5100 Series, calibration lab and production line managers were forced to write elaborate test procedures to convert the complex specifications into a step-by-step procedure for inexperienced workers. Or they could use expensive, highly-skilled technical people to perform the test without a procedure. These methods sometimes exceeded the initial cost of the instrument by three to five times over a 5-year period.

Operating the 5100B Series is simple, making it easy to train your operators. And all data is entered via a calculator-type keyboard. No need to convert volts to dBm or dBm to volts, for example. And the 5100B Series performs the mathematical computations associated with calculating the error of the unit-under-test (UUT) – in % or in dB. It then indicates to the operator whether the UUT passed or failed, according to its specified uncertainty and the magnitude of the error.

The 5100B Series calibrates meters quickly and efficiently. It is no longer necessary to gather together separate calibration instruments requiring complex interconnection and operation. A single 5100B Series does the whole job.

5101B Has System Features

The 5101B is designed for the user who needs the automated features of a large computer aided calibration system without the hardware and software costs of a large system.

A typical calibration procedure consists of forty or fifty separate steps. For most benchtop systems, each step must be loaded into the calibrator – an operation that is slow and prone to human error. The 5101B has a built-in cassette tape deck to store calibration procedures and step through them under microprocessor control.

Initially, the operator records the procedure on a mini cassette. Once recorded, the procedure can be repeated in a fraction of the usual time. Preparing the calibration tape and operating the 5101B, requires no special knowledge of computers or computer languages. Using a printer and interface option with the 5101B, you can document both the calibration procedure and the test results with a hard-copy record.

5102B Has Rugged Case

The 5102B is similar to a 5100B but constructed in a rugged combination case with removable sealed end covers for military applications. It is not rackmountable.

Automated Calibration

The 5100B Series can be used in computer-aided calibration applications by adding a Fluke 1722A Instrument Controller and 7411B Calibration Software. Examples of calibration procedures are included in the software packages. Consult your local sales office for details.

Extended Power and Current Capabilities

The 5205A Precision Power Amplifier and the 5220A Transconductance Amplifier will operate as an integrated system with either a 5100B, 5101B, or 5102B. The purpose is to extend the voltage and current sourcing capabilities beyond the basic built-in capabilities of the 5100B Series Calibrators.

High voltage loading may be extended from 6 mA maximum to 100 mA maximum at 1100V for direct voltage. And alternating volt-Hertz limits may be extended from 20V at 50 kHz to 1100V at 50 kHz. Current sourcing may be extended from 2A to 20A.

A Y5000 Interface/Buffer is needed to integrate a 5205A and/or a 5220A with 5100B Series. It connects to the rear panels and preserves the advantage of single-point control of calibration, automatic error calculation, entry limit protection, etc. The system is operated and controlled using only the front panel of the 5100B/5101B or procecures stored on a 5101B mini cassette.

Specifications

Technical Specifications

Direct Voltage

Range	Resolution	Maximum Current	Ripple and Noise (10 Hz to 3 kHz, NL to FL, RMS)
20 mV	0.1 μV	Limited by 50Ω output resistance or 25 mA using 50Ω overide	0.01 of setting +25 μV**
200 mV	1 μV		
2V	10 μV		
20V	100 μV	25 mA 1000 pF	0.02% of setting + 50 μV
200V	1 mV	10 mA/ 400 pF*	0.05% of setting (open to 20 kΩ) 0.1 of setting (20 kΩ to full load)
1100V	10 mV	6 mA/ 400 pF*	0.05% of setting

*100 mA/1500 pF with 5205A, Y5000 and Y5001

**Double both terms for divider override mode

Uncertainty: ±(0.004% of setting +0.001% of range +5 μV) for all ranges, for 6 months, 20°C to 30°C ambient, non-override; ±(0.005% of setting +0.2 mV) for divider override mode

Temperature Coefficient: Above 30°C and below 20°C, ±(5 ppm of setting +1 ppm of range +1 μV)/°C to 200V, ±(5 ppm of setting +2 ppm of range)/°C, 200V to 1100V

Short Term Stability: (For 10 minutes from 0°C to 50°C) ±(10 ppm of setting +2 ppm of range +5 μV) to 500V; ±25 ppm of setting, 500V to 1100V

Load Regulation: (External Sense) ±10 ppm from 2V to 1100V, no-load to full-load. (Internal Sense) same as external except full-load is 400Ω

Alternating Voltage

Range*	Resolution	Maximum Load	Total Harmonic Distortion and Noise
20 mV	0.1 μV	Limited by 50Ω output resistance	Bandwidth of 10 Hz to 200 kHz, Distortion, line interference + noise including random spikes **20V and Higher** 50 Hz to 10 kHz: 0.08% of output rms **Below 20V** 50 Hz to 10 kHz: (0.05% of output + 10 μV) rms 10 kHz to 50 kHz: (0.08% of output + 20 μV) rms
200 mV	1 μV		
2V	10 μV	2 kΩ/ 1000 pF	
20V	100 μV	25 mA/ 1000 pF	
200V	1 mV	10 mA/ 400 pF	
1100V	10 mV	6 mA/ 400 pF**	

* Can be set in dBm where 0 dBm + 1 mW in 6008 + 0.7746V

**200 mA/1500 pF with 5205A, Y5000 and Y5001

Uncertainty: ±(0.035% of setting +0.005% of range +50 μV) from 50 Hz to 10 kHz and ±(0.06% of setting +0.008% of range +50 μV) from 10 kHz to 50 kHz for 6 months, 20°C to 30°C ambient

Frequencies Available (Hz): 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, and 900 for all voltage ranges.

Frequencies Available (kHz):

Voltage Range	1	2	3	4	5	6	7	8	9	10	20	30	40	50
110V to 1100V	•	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
20V to 110V	•	•	•	•	•	•	•	•	•	•	•	Δ	Δ	Δ
1 mV to 20V	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Δ With 5205A, Y5000, and Y5001

Frequency Uncertainty: ±3%

Temperature Coefficient: Above 30°C and below 20°C ±(20 ppm of setting +2 ppm of range)/°C for amplitude, ±0.1%/°C for frequency

Short Term Stability: ±(0.01% of range +10 μV) for 10 minutes from 0°C to 50°C

Load Regulation: External Sense, ±200 ppm from 0.2V to 1100V, no-load to full-load; Internal Sense, same as external except regulation for voltages <0.2V is expressed as an output impedance of 50Ω

Direct Current

Range	Resolution	Compliance Voltage	Ripple and Noise
200 μA	1 nA	0 to 10V	(0.05% of output +0.01 μA) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 μA		
2A*	10 μA	0 to 2.1V	

*20A with 5220A, Y5000, and Y5002

Uncertainty: ±0.015% of setting +0.002% of range +0.01 μA) for compliance voltage up to 1V. Add 0.002% of setting per volt above 1V rms. Applies for 6 months and 20°C to 30°C ambient

Temperature Coefficient: Above 30°C and below 20°C ±(10 ppm of setting +2 ppm of range)/°C

Short Term Stability: ±(50 ppm of setting +5 ppm of range +0.002 μA) for 10 minutes from 0°C to 50°C

Load Regulation: ±20 ppm/volt for change in output voltage from 1 volt to maximum compliance voltage

Alternating Current

Range	Resolution	Compliance Voltage	Total Harmonic Distortion & Noise
200 μA	1 nA	0 to 7V	(0.05% of output +0.01 μA) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 μA		
2A*	10 μA	0 to 1.4V	

*20A with 5220A, Y5000 and Y5002

Uncertainty: ±0.05% of setting +0.005% of range +0.02 μA) for compliance voltage up to 1V rms (50 Hz to 1 kHz). Add 0.005% of setting per volt above 1V rms. Applies for 6 months in 20°C to 30°C ambient

Temperature Coefficient: Above 30°C and below 20°C ±(25 ppm of setting +10 ppm of range +0.2 nA)/°C for amplitude, +0.1%/°C for frequency

Short Term Stability: ±(0.014% of setting +0.002% of range +0.4 μA) for 10 minutes from 0°C to 50°C

Load Regulation: ±(50 ppm +20 nA)/volt for change in output voltage from 1 volt to maximum compliance voltage

Resistance

Range: 1Ω to 10 MΩ in decade steps
Uncertainty: ±0.003%, except ±0.015% (1Ω), ±0.010% (10Ω and 1 MΩ), and ±0.030% (10 MΩ) assumes 4 terminal below 100 kΩ. 6 mo 20°-30°C
Power Dissipation: 1W maximum except 100 mW max (1 MΩ) and 10 mW max (10 MΩ)
Temperature Coefficient: Above 30°C and below 20°C, ±5 ppm/°C except ±10 ppm/°C (1Ω and 10Ω), ±10 ppm/°C up to 40°C (10 MΩ), and ±50 ppm/°C above 40°C (10 MΩ)

Extended Specifications

Direct Voltage (with 5205A)

Range: ±100V to ±1100V, with 10 mV resolution
Maximum Load: 100 mA; 1500 pF
Uncertainty: ±(0.07% of setting +20 mV), for 6 months, 20°C to 30°C ambient
Line-Related Noise: ≤50 mV rms
Random Noise: ≤100 mV rms, 1 MHz bandwidth

Alternating Voltage (with 5205A or 5215A)

Voltage Range: 100V to 1100V rms, with 10 mV resolution
Maximum Load: 200 mA, decreasing linearly to 140 mA from 100 Hz to 50 Hz; 1500 pF
Voltage Uncertainty: ±(0.08% of setting +0.1V) for 50 Hz to 10 kHz; ±(0.12% of setting + 0.15V) for 10 kHz to 50 kHz, for 6 months, 20°C to 30°C ambient
Frequency Range: Discrete selections from 50 Hz to 50 kHz with 1 MSD resolution
Frequency Uncertainty: ±3%
Harmonic Distortion and Noise: 0.1% of setting from 50 Hz to 20 kHz, 0.2% of setting from 20 kHz to 50 kHz, for bandwidth of 10 Hz to 1 MHz

Direct Current (with 5220A)

Range: ±1A to ±19.9999A, with 100 µA resolution
Compliance Voltage: 0 to 4V
Uncertainty: ±(0.025% of setting +1 mA), for 6 months, 20°C to 30°C ambient
Ripple and Noise: 0.05% of setting +1 mA rms, 10 Hz to 3 kHz bandwidth

Alternating Current (With 5220A)

Current Range: 1A to 19.9999A rms, with 100 µA resolution
Compliance Voltage: 0 to 3V rms
Current Uncertainty: ±(0.07% of setting +1 mA) rms from 50 Hz to 1 kHz, ±(0.07% of setting +1 mA) x frequency (in kHz) from 1 kHz to 5 kHz, for 6 months, 20°C to 30°C ambient
Frequency Range: Discrete selections from 50 Hz to 5 kHz with 1 MSD resolution
Frequency Uncertainty: ±3%
Harmonic Distortion and Noise: ±(0.07% of setting +1 mA) rms, for bandwidth of 10 Hz to 300 kHz

Option Specifications

Wideband aV Option (-03)

Option -03 is a high accuracy, low noise, extremely flat alternating voltage source which increases the frequency coverage of the 5100B Series from its standard of 50 Hz to 50 kHz to 10 Hz to 10 MHz. This option enables the 5100B Series to calibrate wideband meters. A dedicated front panel BNC connector provides ac output from 300 µV (-57.5 dBm) to 3.1623V (+23 dBm) into 50Ω impedance. The output is programmable from the front panel or I/O interface in volts or in dBm (where 0 dBm equals 1 mW into 50Ω). Using a simple formula for calculation of a correction factor and the NEW REF feature, the wideband output can be directly programmed for dBm referenced to other impedances.

With the EDIT control the error of wideband meters can be calculated in % or in dB. With the EDIT control and NEW REF, you may test the frequency response of meters. This method provides a direct reading in percent or dB, ideal for making Bode plots.
Range: 10 Hz to 10 MHz

Amplitude Uncertainty, at 1 kHz, Terminated in 50Ω*

Voltage Range	Approx dBm Range	±(% of Setting + % of Range)
1V-3.1623V	+13 to +23	0.25 + 0.25
0.31624V-0.99999V	+3 to +13	0.5 + 0.25
0.1V-0.31623V	-7 to +3	0.75 + 0.25
31.624mV-99.999mV	-17 to -7	1.0 + 0.25
10mV-31.623mV	-27 to -17	1.25 + 0.25
3.1624mV-9.9999mV	-37 to -27	1.5 + 0.25
1mV-3.1623mV	-47 to -37	1.75 + 0.25
300µV-0.99999 mV	-57.5 to -47	2.0 + 0.25

**For 6 months, 20°C to 30°C ambient*

Amplitude Flatness*
10 Hz to 30 Hz: ±0.3%
30 Hz to 1 MHz: ±0.25%
1 MHz to 5 MHz: ±0.25% above 1 mV, ±0.6% ≤1 mV
5 MHz to 10 MHz: ±0.6%
**Using 1 foot of RG 58U cable terminated in 50Ω*
Temperature Coefficient: Above 30°C and below 20°C ±(0.1 times basic accuracy)/°C for amplitude; ±0.25%/°C for frequency
Harmonics: -40 dB or lower relative to fundamental for each frequency except -32 dB above 5 MHz
Spurious Outputs: -50 dB or lower relative to fundamental for each frequency
Frequency Resolution: 1 MSD
Frequency Uncertainty: ±3%

IEEE-488 Interface Option (-05)

This interface allows the 5100 Series B to be used in a system compatible with IEEE Std 488-1978. System control is via the Fluke 1722A or 1752A Instrument Controller or any host computer. Address coding is done using logic switches accessible on the rear panel. Data is transmitted bi-directionally in ASCII coded for format. The following subsets are supported: SH1, AH1, T6, L4, SR1, RL1, DC1, and E2.

Bit Serial Interface Option (-06)

Provides compatibility with EIA Standard RS-232-C or 20 mA current loops. Thirteen baud rates are available from 50 to 9600 and either one or two stop-bits can be set up. Selection is made via rear panel logic switches.

General Specifications

Shock and Vibration: Meets requirements of MIL-T-28800 for Class 5, Style E equipment
Temperature
5100B and 5102B: 0°C to 50°C operating; -20°C to +65°C non-operating
5101B: (With mini cassette tape) +10°C to +40°C operating; +4°C to +50°C, non-operating. Without mini cassette: same as 5100B
Relative Humidity: 185% to 35°C, ≤70% to 40°C, ≤50% to 50°C
Power: 100, 110, 115, 120, 200, 220, 230, 240V ac, switch-selectable ±10%, 50 Hz to 60 Hz. 200VA (5100B) or 220VA (5101B) with all options Size: 22.2 cm H x 60.3 cm W x 43.2 cm L (8.75 in H x 17 in W x 23.75 in L)
Weight
5100B: 30.4 kg (67 lb) basic, 32.7 kg (72 lb) with all options
5101B: 32.7 kg (72 lb) basic, 34.9 kg (77 lb) with all options
5102B: 35.8 kg (79 lb) basic, 38.1 kg (84 lb) with all options
Included: Manual, power cord, serialized and dated Calibration Certificate. Also one mini cassette tape with 5101B

Ordering Information

Models

January 1989 prices

5100B Calibrator	$11,450
5101B Calibrator, w/procedure storage	14,400
5102B 5100B in portable case	15,250
5205A* Power Amplifier	9950
5220A* Transconductance Amplifier	5650

** Y5001 or Y5002 cable and Y5000 interface required when used with 5100B Series Calibrator*

Options (for 5100B, 5101B, 5102B)

-03 Wideband AC Voltage	3100
-05 IEEE-488 Interface	650
-06 EIA RS-232-C Interface	650

Accessories (Also see page 485)

5100B-7003K Fiberglass Case, for 5100B/5101B	1095
5100B-7005K Module Extender Kit	550
M08-205-600 8-3/4" Rack Adapter, 5100B/5101B	110
M00-280-610* 24" Rack Slides	130
Y5000 Interface Buffer for 5205A, 5215A and 5220A	600
Y5001 Cable for 5205A/5215A and Y5000	275
Y5002 Cable for 5220A and Y5000	240
Y8021 1m Cable for IEEE-488 bus	130
Y8022 2m Cable for IEEE-488 bus	145
Y8023 4m Cable for IEEE-488 bus	155
Y8004 1.5m Printer Cable for RS-232-C	110
Y8007 10-pack of mini cassettes for 5101B	150

**Requires M08-205-600*

National Stock Numbers

5100B	6625-01-099-2414
5101B	6625-01-105-3598
5102B with -03 and -05	6625-01-233-7104

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Percent and PPM

Calibrator and meter uncertainty specifications are usually given as either percent or parts per million (ppm). These are interchangeable concepts. We have chosen to use the term "ppm" for the most part, mainly to make the numbers more easily readable by reducing the number of zeros. This table will give you an idea of how they relate:

0.1% = 1000 ppm
0.01% = 100 ppm
0.001% = 10 ppm
0.0001% = 1 ppm

An easy memory aid to use is 0.01% and 100 ppm. Reverse the order of the numbers in 0.01% and it comes out as 100 ppm.

5440B & 5442A

GPIB IEEE-488

RS-232

NSN 6625-01-226-5448 **5440B**

5440B & 5442A Direct Voltage Calibrators

- Full accuracy over extended temperature range of 10°C
- Completely automatic internal calibration, no mechanical adjustments
- Simplified 5-minute external calibration to traceable standards
- Procedure Storage Module for single button test setup (5440B only)
- Completely programmable through the IEEE-488 interface
- Serial printer output for calibration constants and instrument test results

The 5440B and 5442A are equipped with bright vacuum-fluorescent displays for clear visibility at any viewing angle. Even inexperienced operators find the 5440B and 5442A easy to use because the 40-character, alphanumeric display provided in addition to the numeric output display makes operating instructions and error messages clear and readable in engineering units and English language messages instead of coded numerics. For semi-automated testing, the 5440B allows a complete test sequence of up to 60 steps to be stored in the internal Procedure Storage memory and recorded for later use in the interchangeable, plug-in Procedure Storage Modules. A test sequence is recalled and executed one step at a time with each touch of the NEXT STEP key.

The differences between the 5440B and the 5442A are in the operating features and specifications. The 5440B comes equipped with the Procedure Storage Module capability and boost capability for driving the 5205A Precision Power Amplifier and 5220A Transconductance Amplifier in system applications. The rear output terminals found on the 5440B as a standard feature are available for the 5442A as an option. Both instruments have outstanding accuracy specifications and the capability for operating at full rated accuracy over a temperature range of ±5°C from the calibration temperature, making them well-suited for operation in a production environment as well as in a standards lab. Both instruments are completely programmable via the IEEE-488 interface which is included at no extra cost.

The outstanding accuracy specifications for the 5440B and 5442A are easily maintained in any lab by performing the simple, automatic calibration procedures which store the calibration constants in non-volatile solid-state memory. No hardware adjustments are required. The Fluke 732A Reference Standard combined with the Fluke Direct Volt Maintenance Program and the Fluke 752A Reference Divider, provide the highest accuracy reference standards available for this periodic calibration.

Specifications

Specifications apply to both the 5440B and 5442A unless otherwise noted.

Output Voltage: 0 to 1100V

Output Current: 0 to 60 mA up to 22V, except divided outputs; 0 to 25 mA up to 1100V

5440B:

Output Uncertainty Compared to Calibration Standards, ±5°C

Range	Uncertainty Specification: ±(PPM of Output + Microvolts)	
	30 Days	**90 Days**
0V to 11V	1.5 + 5 μV	2.0 + 5 μV
11V to 22V	1.5 + 8 μV	2.0 + 8 μV
22V to 275V	2.5 + 100 μV	3.5 + 100 μV
275V to 1100V	2.5 + 400 μV	3.5 + 400 μV
Divided Output		
0V to 220 mV	4 + 0.5 μV	5 + 0.5 μV
0.22V to 2.2V	3 + 1 μV	4.5 + 1.0 μV
Range	**180 Days**	**1 Year**
0V to 11V	2.5 + 5 μV	3.5 + 5 μV
11V to 22V	2.5 + 8 μV	3.5 + 8 μV
22V to 275V	4.5 + 100 μV	6.0 + 100 μV
275V to 1100V	4.5 + 400 μV	6.0 + 400 μV
Divided Output		
0V to 220 mV	6.5 + 0.5 μV	10 + 0.5 μV
0.22V to 2.2V	6 + 1.0 μV	8 + 1.0 μV

5442A:

Output Uncertainty Compared to Calibration Standards, ±5°C

Range	Uncertainty Specification: ±(PPM of Output + Microvolts)	
	30 Days	**90 Days**
0V to 11V	2.5 + 5 μV	3.0 + 5 μV
11V to 22V	2.5 + 8 μV	3.0 + 8 μV
22V to 275V	3.0 + 100 μV	3.5 + 100 μV
275V to 1100V	2.5 + 400 μV	3.5 + 400 μV
Divided Output		
0V to 220 mV	6 + 0.5 μV	7 + 0.5 μV
0.22V to 2.2V	4 + 1 μV	6 + 1.0 μV
Range	**180 Days**	**1 Year**
0V to 11V	4.5 + 5 μV	6.5 + 5 μV
11V to 22V	4.5 + 8 μV	6.5 + 8 μV
22V to 275V	5.0 + 100 μV	7.0 + 100 μV
275V to 1100V	4.5 + 400 μV	6.0 + 400 μV
Divided Output		
0V to 220 mV	9 + 0.5 μV	12 + 0.5 μV
0.22V to 2.2V	8 + 1.0 μV	11 + 1.0 μV

Uncertainty of Calibration Standards Compared to National Standards

Range	Uncertainty of Standards
0V to 11V	1.5 ppm
11V to 22V	1.5 ppm
22V to 275V	1.7 ppm
275V to 1100V	2.0 ppm
0V to 220 mV	4.0 ppm
0.22V to 2.2V	2.0 ppm

The output uncertainty compared to national standards for the 5440B and 5442A are defined as the algebraic sum for each range of the output uncertainty compared to calibration standards and the uncertainty of the calibration standards

5440B & 5442A

compared to national standards. The specifications for uncertainty of calibration standards listed above are those for the Fluke 732A and Fluke 752A. If other standards are used, the uncertainty of those standards must be substituted.

Output Stability

Specifications apply for initial stabilization of two hours, constant ambient temperature of ±1°C, constant line voltage, constant load, and measurement bandwidth of 0.1 Hz to 1 Hz.

Range	±(PPM of Output + Microvolts)		
	10 Minutes	24 Hours	30 Days*
0V-11V	0.2+2 µV	0.3+3 µV	0.5+3 µV
11V-22V	0.2+3 µV	0.4+4 µV	0.5+4.5 µV
22V-275V	0.3+40 µV	0.3+50 µV	1.0+60 µV
275V-1100V	0.3+200 µV	0.3+200 µV	1.0+300 µV
Divided Output			
0 mV-220 mV	0.5+0.2 µV	0.5+0.2 µV	2+0.3 µV
0.22V-2.2V	0.5+0.2 µV	0.5+0.5 µV	2+0.7 µV

** For best results, use internal calibration for periods exceeding one day.*

Temperature Coefficient of Output

These specifications apply for ambient temperatures outside the ±5°C range of the uncertainty specifications listed earlier.

Range	±(PPM of Output) Per °C	
	0-10°C	10-30°C
0V to 11V	0.15 ppm	0.1 ppm
11V to 22V	0.15 ppm	0.1 ppm
22V to 275V	0.2 ppm	0.2 ppm
275V to 1100V	0.2 ppm	0.2 ppm
Divided Output		
0V to 220 mV	0.5 ppm	0.5 ppm
0.22V to 2.2V	0.5 ppm	0.5 ppm
Range	**30-40°C**	**40-50°C**
0V to 11V	0.4 ppm	1.0 ppm
11V to 22V	0.4 ppm	1.0 ppm
22V to 275V	0.6 ppm	1.5 ppm
275V to 1100V	1.0 ppm	1.5 ppm
Divided Output		
0V to 220 mV	0.5 ppm	0.5 ppm
0.22V to 2.2V	0.5 ppm	0.5 ppm

Linearity

These specifications apply for the ambient temperature range of 15°C to 30°C within ±5°C of the external calibration temperature.

Range	±(PPM of Output + Microvolts)
0 mV to 220 mV	0.5 ppm + 0.2 µV
0.22V to 2.2V	0.7 ppm + 0.3 µV
0V to 11V	0.5 ppm + 1.5 µV
11V to 22V	0.5 ppm
22V to 275V	0.5 ppm + 40 µV
275V to 1100V	1.0 ppm

Resolution

Range	Resolution	Maximum Load or Output Resistance
0V to 11V	1 µV	25 mA
11V to 22V	1 µV	
22V to 275V	10 µV	
275V to 1100V	100 µV	
Divided Output		
0V to 220 mV	0.01 µV	495Ω
0.22V to 2.2V	0.1 µV	450Ω

Output Noise

Range	Bandwidth	
	0.1 Hz to 10 Hz	10 Hz to 10 kHz
0 mV to 220 mV	0.1 µV	5 µV
0.22V to 2.2V	0.2 µV	15 µV
0V to 11V	1.5 µV	30 µV
11V to 22V	3.0 µV	50 µV
22V to 275V	35 µV	150 µV
275V to 1100V	100 µV	300 µV

Output Settling Time

Time to settle within a given uncertainty band of final value, for a change in programmed output within a given range.

Range	±Parts Per Million of Change*		
	3 seconds	5 seconds	10 seconds
0 mV to 220 mV, 0.22V to 2.2V, 0V to 11V, and 11V to 22V	7 ppm	2 ppm	0.5 ppm
22V to 275V 275V to 1100V	–	–	3 ppm

** Add 0.5 seconds for any change in range up to 22V, 1.0 second for a change from 22V up, and 0.5 seconds for a change from STBY to OPER.*

Line Regulation: Changes less than ±0.1 ppm of range for ±10% change from nominal line voltage

Load Regulation: Less than ±0.1 ppm change of output for change from no-load to full-load or from full-load to no-load for output load impedances greater than 80 ohms

Common Mode Rejection: Greater than 140 dB for frequencies from dc to 400 Hz

Temperature: 0°C to 50°C, operating, except accuracy is degraded above 40°C due to loss of oven regulation; -40°C to +75°C non-operating

Relative Humidity: ≤90% to 30°C except accuracy is degraded above 80%, ≤70% to 40°C, ≤40% to 50°C

Vibration

Frequency	Force	Double Amplitude
5 Hz to 15 Hz	0.7G at 15 Hz	0.06 inches
15 Hz to 25 Hz	1.3G at 25 Hz	0.04 inches
25 Hz to 55 Hz	3G at 55 Hz	0.02 inches

Shock: Eighteen 20G 1/2-sinewave shocks

Compliance With External Standards: ANS C39.5 Dec 1980 and IEC 348 Second Edition 1978

EMI/RFI Review Standards: FCC Rules Par 15, Subpart J; European Standard VDE 0871 MIL STD 461B

EMI/RFI Conducted Emissions: FCC Rules Part 15 Class J; European Standard VDE 0871 CISPR.11

Radiated EMI/RFI Emissions: Meets or exceeds all FCC and VDE requirements

Power: 100V, 110V, 115V, 120V ac ±10% or 200V, 220V, 230V, 240V ac ±10%, 50 to 60 Hz 84W Standby, 145W nominal

Size: 61 cm L x 43 cm W x 24 cm H (24 in x 17 in x 9.4 in)

Weight: 30.2 kg (66.4 lb)

Mounting: Standard 19" EIA relay rack, tapped for attachment of slides; resilient feet provided for bench use

Included: Operator's and Service Manual, serialized and dated Calibration Certificate

5440B: Procedure Storage Module, IEEE-488 Interface, RS-232-C Printer Interface, Boost Interface, Rear Output

5442A: IEEE-488 Interface, RS-232-C Printer Interface

Ordering Information

Models

January 1989 prices

5440B Direct Voltage Calibrator NSN 6625-01-226-5448	$13,650
5442A Direct Voltage Calibrator NSN 6625-01-224-9270	11,550

Accessories (Also see page 485)

5440A-7001 Spare Procedure Storage Module	230
5440A-7002 Low Thermal Copper EMF Plug-In Cables	350
732A DC Reference Standard	3800
732A-000 w/Special Calibration, shipped hot	4040
732A-100 w/Special Calibration and Drift Certification, shipped hot	4245
752A Reference Divider	5190
M08-205-600 8³/₄" Rack Mount Kit	110
M00-280-610 24" Rack Slide Kit (Requires M08-205-600)	130
5442A-01 Rear Output Option	345

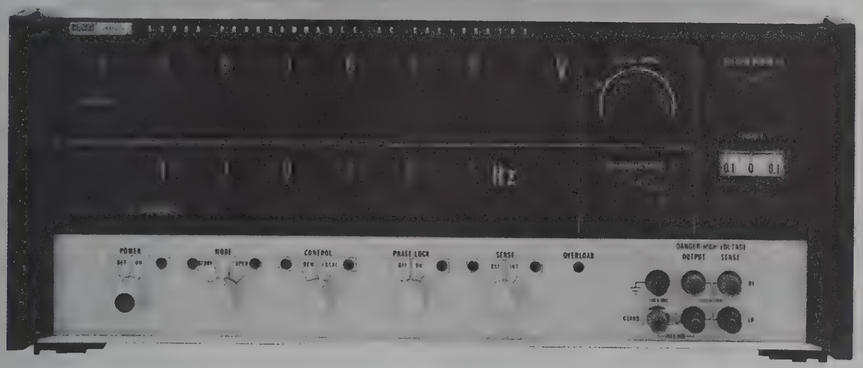
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

5200A

GPIB
IEEE-488



(NSN 6625-01-063-6325) **5200A**

5200A Precision Alternating Voltage Calibrator

- 120 ppm point uncertainty available
- Seven voltage ranges from 1 mV to 1000V
- 6½ digit resolution
- Output frequencies from 10 Hz to 1 MHz
- Automated characterized operation available
- GPIB/IEEE-488 system interface available
- Phase-lock input
- Completely guarded
- Short and overload protected

A Proven Performer

The Model 5200A Alternating Voltage Calibrator is a precision high-performance alternating voltage source with proven reliability and exceptional stability and accuracy over a broad frequency range. It is specified over a wide 0°C to 50°C operating range for use in both laboratory and manufacturing environments. Amplitude is controlled in six ranges from 1 mV to 100V. Resolution to 1,199,999 counts yields 20% overrange capability with 1 nanovolt steps on the 1 mV range, up to 0.1 mV steps on the 100V range. Outputs from 100 μV rms to 120V rms are provided, with up to 50 mA load current capability.

An additional 1000V range is included for front panel or remote interface control of a 5205A or 5215A Precision Power Amplifier.

Amplitude error measurement for voltmeter calibration is provided in two ranges, ±3% and ±0.3%. Error measurements can be resolved to 10 ppm.

Five frequency ranges are provided from 100 Hz to 1 MHz, with 119,999 count resolution for 20% overrange capability with 0.01 Hz steps on the 100 Hz range, up to 100 Hz steps on the 1 MHz range.

The oscillator of the 5200A may be phase locked to an external source to produce synchronous signals of precision amplitude and stability. Signal phase is locked within ±1° of phase angle, ±0.05°/kHz, over a ±2% band around the center frequency. This capability is essential for 60 Hz calibration.

A 3V pulse signal is provided for monitoring frequency with an external counter.

A quadrature output signal is provided which leads the fundamental signal phase by 90°. Amplitude varies from 1V to 10V rms, proportional to the fundamental signal output level on any range. This signal is useful for wattmeter calibration, and for research and development tasks that use the 5200A as a precision source.

External sensing may be selected, bringing rated accuracy to the load point bypassing losses in output leads.

Outputs are protected from overload by current limiting. Overload response time is typically 2 microseconds. When an overload is removed output recovers automatically to its previous level.

The 5200A is a fully guarded calibrator. This allows floating operation, and eliminates system ground loop problems. This is especially useful for calibrating non-guarded equipment.

Remote Programming (Opt -01 or -05)

The 5200A is remotely programmable in all functions except Power, Remote/Local, and Vernier Voltage Error. For any programmed amplitude, the output settles to its specified uncertainty within 0.5 seconds for frequencies above 100 Hz, and within 4 seconds for frequencies below 100 Hz. Program status flags are provided to indicate settling time and current limit conditions to the controller.

Either the 5200A-01 Parallel Remote Control Interface or the 5200A-05 GPIB/IEEE-488* System Interface may be installed in the 5200A, for complete remote control of both the 5200A Calibrator and a 5205A or 5215A Power Amplifier.

The 5200A-01 Parallel Remote Control Interface provides excellent isolation between external system logic and internal calibrator circuitry. This isolation is typically $10^9\Omega$ in parallel with 30 pf capacitance. This effectively attenuates external logic and ground noise better than 100:1 at 10 MHz.

Command data is segmented into 4-bit groups that can be programmed separately or simultaneously. Command data is stored both inside and outside the guard.

5200A-01 programming levels are compatible with TTL logic, and with contact closure:

Standard levels:
Logic 1 or true = 0 to +0.4 dV
Logic 0 or false = +2.8V to +5.0 dV
(For inverted logic levels, also order option 5200A-03.)

The 5200A-01 includes both standard and blank address matrix cards, and a mating connector.

The 5200A-05 IEEE-488 System Interface incorporates subsets SH1, AH1, T6, TEO, L4, LEO, SR1, RLO, PPO, DC2, and DTO of IEEE Standard 488-1980. The 5200A-05 may be addressed for a 2-byte status response or serial polled for a 1-byte response. Status information includes Remote/Local, Standby/Operate, limits, settling time, and out-of-range instruction.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

5200A

Automated Characterized Operation

The established excellent stability and performance history of the 5200A Alternating Voltage Calibrator offers an opportunity for further reducing calibration uncertainty while greatly simplifying use.

Characterization is a process of measuring a particular calibrator's uncertainties at selected points using traceable transfer standards and recording those uncertainties in a table. When the selected points are used, the portion of these uncertainties not due to the transfer standards or to the characterization process can then be added to (or subtracted from) the calibrator setting. In practice, this significantly reduces calibrator uncertainty.

Mathematical interpolation methods are used for points other than those selected for characterization. While this yields a significant improvement in uncertainty specifications, it can be complex and time consuming when done manually.

Option 5200A-800 is a software package that uses a Fluke 1722A or 1752A Instrument Controller to operate a 5200A Alternating Voltage Calibrator and a 5205A or 5215A Precision Power Amplifier. This software makes use of a stored characterization table and automatically interpolates for voltages and frequencies selected between characterization points.

The 5200A-800 controls all calibrator functions in a simplified manner with the touch-sensitive display of the 1722A or 1752A.

Calibration

The 5200A is originally calibrated at the factory by instrumentation traceable to the U.S. National Bureau of Standards. Periodic traceable recalibration service is available through Fluke Technical Service Centers and Sales Representatives worldwide.

Fluke also offers 5200A characterization service as well as 540B characterization for customers doing their own 5200A characterization. The table of correction factors is supplied in written form, and on a disk compatible with the 5200A-800.

Specifications

Technical Specifications

Amplitude Uncertainty

Specified for 180 days. Characterized uncertainty requires optional 5200A-900 characterization. Both specifications are valid when operating in an ambient temperature between 18°C and 28°C after a 1-hour warmup.

Basic Instrument Absolute Uncertainty[1]			Characterized Uncertainty[2]		
Voltage Ranges	Frequency Hz	±(ppm setting + µV)	Frequency Hz	±(ppm setting + µV)	
				Relative	Absolute
1 mV[3] 10 mV	10-30	1000+10			
	30-20K	200+10			
	20K-100K	500+20			
	100K-1M	3300+30			
100 mV	10-30	1000+10	50-100	130+10	150+10
	30-20K	200+10	100-20K	125+10	145+10
	20K-100K	500+20	20K-50K	180+20	250+20
	100K-1M	3300+30	50K-100K	200+20	470+20
		±(ppm setting + ppm range)		±(ppm setting+ppm range)	
1V 10V 100V	10-30	1000+50	50-100	130+20	150+20
	30-20K	200+20	100-20K	125+15	145+15
	20K-100K	500+50	20K-50K	180+20	250+20
	100K-1M	3300+30	50K-100K	300+30	470+30
1000V[4]	10-30	1200+50	50-100	190+20	210+20
	30-20k	400+40	100-10k	180+20	180+20
	20k-50k	800+50	10k-20k	200+20	200+20
	50k-100k	1000+100	20k-50k	310+30	310+30

Notes:

1. Valid for 180 days, between 18°C and 28°C, after 1-hour warm-up

2. 180 days. Requires 5200A-900

3. On 1 mV range, specification applies for measuring instruments with less than 2 MHz bandwidth.

4. Output is through a 5205A or 5215A Power Amplifier

Characterized-Point Absolute Uncertainty, ±ppm*									
Voltage	Frequency, Hz								
	50	100	200	1k	2k	10k	20k	50k	100k
0.5	125	125	–	125	–	125	–	210	450
1	120	120	120	120	120	120	120	200	450
3	130	130		130	130	130		220	450
10	120	120	120	120	120	120	120	200	450
30	130	130		130	–	130	–	220	450
100	120	120	120	120	120	120	120	200	450
300	190	190	–	190	–	190	–	630	–
1000**	180	180	180	180	180	180	200	610	–

** 180 days. Requires 5200A-900. Traceable to U.S. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques*

*** Output is through a 5205A or 5215A Power Amplifier.*

Voltage Resolution

Range	Voltage Settings	Resolution
1 mV	0.100000 mV to 1.199999 mV	1 nV
10 mV	1.00000 mV to 11.99999 mV	10 nV
100 mV	10.0000 mV to 119.9999 mV	100 nV
1V	0.100000V to 1.199999V	1 µV
10V	1.00000V to 11.99999V	10 µV
100V	10.0000V to 119.9999V	100 µV
1000*	100.000V to 1199.999V	1 mV

**Output is through a 5205A or 5215A Power Amplifier*

Stability

Voltage Ranges	Frequency Hz	Stability[1] (ppm setting + ppm range)[2]	
		10 Minutes	180 Days
1 mV 10 mV	10 - 30	70 + 40	300 + 60
	30 - 20k	70 + 3[3]	100 + 30
	20k - 100k	70 + 3	130 + 40
100 mV	10 - 30	70 + 40	300 + 60
	30 - 1k	70 + 3[3]	70 + 40
	1k - 20k	70 + 3	100 + 30
	20k - 50k	70 + 3	120 + 50
	50k - 100k	70 + 3	100 + 130
1V 10V 100V	10 - 30	70 + 40	200 + 20
	30 - 20k	35 + 5[3]	45 + 5
	20k - 50k	55 + 5	65 + 5
	50k - 100k	70 + 3	220 + 20
1000V[4]	10 - 100	0 + 50	200 + 0
	100 - 20k	70 + 5	200 + 0
	20k - 100k	70 + 5	400 + 0

Notes:

1. Constant line, load, and temperature.

2. Total peak to peak random change in rms value.

3. For frequencies below 50 Hz, floor is 40 ppm of range.

4. Output is through a 5205A or 5215A Power Amplifier.

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C; for the 1000V range add ±(0.03 x uncertainty) per °C

Maximum Load: 1 mV, 10 mV, 100 mV ranges: minimum 6000Ω load impedance; 1V,* 10V, 100V ranges: maximum load current 50 mA; 1000V range: maximum load current 200 mA

**Minimum load impedance 50Ω above 0.1 MHz*

Voltage Error Control: Switch selectable OFF, on two ranges: 0 to ±0.3% with 10 ppm resolution; 0 to ±3% with 100 ppm resolution

Settling Time

Frequency Hz	Settling Time,* Seconds
10 - 30	4 to 15
30 - 100	4
100 - 400	2
400 - 1M	1**

** To within 100 ppm of change*

*** Typically less than 0.5 second, except frequency range changes*

External Sense: Switch selectable, internal or external, available on 1V, 10V, and 100V ranges.* Output rises to less than 2.0V rms above selected level when sense lines are disconnected in external sense mode

** Output impedance on 1 mV, 10 mV, and 100 mV ranges is less than 1.5Ω in series with 15 μH*

Frequency Performance*

Range	Frequency Settings	Resolution Hz**	Uncertainty ±(% of input + % of Range)
100 Hz	10.00 Hz to 119.99 Hz	0.01	1.0 + 0.1
1 kHz	.1000 kHz to 1.1999 kHz	0.1	
10 kHz	1.000 kHz to 11.999 kHz	1	
100 kHz	10.00 kHz to 119.99 kHz	10	
1 MHz	.1000 MHz to 1.999 MHz	100	3.0 + 0.3

** 180 days, 18°C to 28°C, after 1-hour warm-up*

***100 ppm of range*

Total Harmonic Distortion and Line-Related Noise*

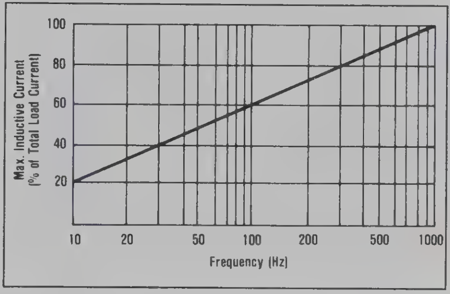
Frequency Hz	±(% of setting + μV rms)
10k - 100k**	0.04% + 10
100k - 500k	0.3% + 30
500k - 1M	1.0% + 30

** Bandwidth 10 Hz to 10 MHz, and less than 15 mA output current except 1000V range. See 5205A or 5215A specifications*

*** 1V range is ±0.08% from 10 Hz to 15 Hz*

Maximum Capacitive Load: 1000 pF on 1 mV-100V ranges, 1500 pF on 1000V range

Maximum Inductive Load Current: (Except 1000V range)



Phase Lock Input: 1V to 10V rms, useable down to 100 mV rms

Phase Lock Accuracy: ±3° below 30 Hz, and ±(1° + 0.05° per kHz) over a ±2% band around center frequency

Quadrature Output:

Amplitude: 1V to 10V rms, ±10%, proportional to selected output voltage

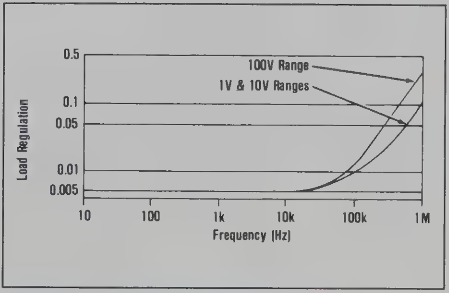
Phase: 10 Hz-40 Hz, 90° ±3°; 40 Hz to 1.2 MHz, 90° ±(1° + 0.03° per kHz)

Minimum Load: 3 kΩ impedance

Current Limit: Typical transition time, 2 μs. Recovery within specified settling time

Volt-Hertz Product: Output voltage x frequency ≤10^7. Full 120V rms output is maintained up to 83.33 kHz. Maximum output voltage at 1.2 MHz is 8.33V rms

Load Regulation: 50 ppm of range, no load to full load, up to 10 kHz



General Specifications

Maximum Isolation Voltages: (dc or peak ac) 500V, GUARD to chassis; 100V, LO to GUARD

Temperature: 0°C to +50°C operating, -40°C to +75°C storage

Input Power: Switch selectable, 100V, 115V, 200V, 230V ac, 100W

Size: 17.8 cm H x 43.2 cm W x 53.3 cm D (7 in x 17 in x 22.5 in)

Weight: 24.1 kg (53 lb)

Includes: Instruction manual, mating connectors, power cord, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

5200A Precision Alternating Voltage Calibrator	$10,950
5205A AC/DC Precision Power Amplifier	10,450
5215A Precision Power Amplifier	9750
5200A/5215A Precision Alternating Voltage Calibration System	20,700
1722A Instrument Controller	6990

Options (for 5200A)

-01* Parallel Remote Control Interface	1360
-03 Logic Level Inversion (for 5200A-01)	225
-05** IEEE-488 System Bus Interface	2100
-800*** Automated Characterized Operation Software	550
-900 Characterization of New-Purchase 5200A and 5215A	895
-902 Characterization of New-Purchase 5200A	730

** Cannot be used with 5200A-05*

*** Cannot be used with 5200A-01*

**** Requires 1722A, 1752A or 1720A, and 5200A-900 or 5200A-902*

Accessories (Also see page 485)

M07-205-600 Rack Mount Kit for 5200A	110
M10-205-600 Rack Mount Kit for 5215A	110
M00-280-610 24" Rack Slides for rack adapter	130
Y1790 Rack Mount Kit w/24" Slides for 1722A	195
5200A-7015K Extender Board Kit	315

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-5200A Repair (w/calibration)	479
SC1-5200A Repair (cal w/in or out data)	554
SC1-5200A Repair (cal w/in & out data)	629
SC2-5200A Cal	348
SC2-5200A Cal (w/in or out data)	498
SC2-5200A Cal (w/in & out data)	648
SC1-5215A Repair (w/calibration)	772
SC1-5215A Repair (cal w/in or out data	847
SC1-5215A Repair (cal w/in & out data)	922
SC2-5215A Cal	462
SC2-5215A Cal (w/in or out data)	612
SC2-5215A Cal (w/in & out data)	762

5450A

NSN 6625-01-249-6325 **5450A**

5450A Resistance Calibrator

- 17 standard resistors in one enclosure
- Decade values from 1.0Ω to 100 MΩ
- 1.9 multiples from 1.9Ω to 19 MΩ
- True passive resistors for low noise and offset
- Midband accuracy of 8 ppm over 18°C to 28°C
- 4-wire or 2-wire operation
- Easy data entry for test lead compensation
- Automatic meter error calculation
- IEEE-488 programmable

The 5450A Resistance Calibrator is designed to verify the resistance-measuring accuracy of precision multimeters, either manually or as part of an automated calibration process. It complements the 5440A and 5442A Direct Voltage Calibrators.

The 5450A provides cardinal point resistance values in decade steps from 1Ω through 100 MΩ and decade steps from 1.9Ω through 19 MΩ.

Each resistor differs from its nominal value by no more than 0.1%. But the precise value of each is known with a much higher degree of certainty. The known value of each is stored internally and used for calibration purposes. Each value displayed has 1 ppm resolution.

Four-wire connections eliminate the effects of lead resistance or, for 2-wire operation, you may measure and store the lead resistance value and automatically subtract it from the value of each resistor. Connections to the instrument being calibrated may be made to the front panel terminals or to special rear panel binding posts that contribute very low thermal offset voltage errors.

Calibrating the 5450A consists of storing the right values of each resistor. Recalibration can be accomplished without removing the instrument covers, and may even be done remotely over the IEEE-488 bus. A rear panel switch insures integrity of calibration.

The 5450A displays the precise value of each selected resistor and can show the error of the instrument being calibrated either in percent or in parts per million. All functions that can be controlled from the front panel may be controlled remotely via an IEEE-488 bus. No options are required to make the 5450A compatible with the bus; interface circuits are built in.

Specifications

The analog specifications apply when the 5450A is calibrated using a 10 kΩ standard resistor, the absolute value of which is known within ±2 ppm or better and using the ratio calibration method for calibrating resistor values from 10Ω through 100 MΩ. The 1.0Ω and 1.9Ω value must be calibrated by comparison to a 1Ω standard whose absolute value is known within ±5 ppm.

General Specifications

Temperature: 0°C to 50°C, operating
Relative Humidity: ≤70% for rated accuracy
Power: 100, 120, 220, or 240 aV ±10%, 50 to 60 Hz ±5%, ≤50W
Size: 8.9 cm H x 43.2 cm W x 55.4 cm L (3.5 in x 17 in x 21.8 in)
Weight: 9.3 kg (20.4 lb)
Included: Instruction manual, line cord, serialized and dated calibration certificate

Ordering Information

Model

January 1989 prices

5450A Resistance Calibrator	$4750

Accessories (Also see page 485)

Y8021 1m Cable for IEEE-488 bus	130
Y8022 2m Cable for IEEE-488 bus	145
Y8023 4m Cable for IEEE-488 bus	155
M00-260-610* 18" Rack Slides	130
M00-270-610* 20" Rack Slides	130
M00-280-610* 24" Rack Slides	130
Y8599 3" Rack Adapter	70
Y8598 3" Rack Adapter with 22"Slides	130

**Requires Y8599*

Analog Specifications

Uncertainty, For Rated Current, 4-Wire Connections

Nominal Resistance	Absolute Uncertainty (±ppm unless indicated)				Normal Current Ranges	
	23°C±1°C, ≤70% RH		23°C ±5°C, ≤70% RH			
	24 Hours	90 Days	90 Days	1 Year	Lower	Upper
Short	.1mΩ	.1mΩ	.1mΩ	.1mΩ	10 mA	500 mA
1Ω	50	62	75	110	10 mA	100 mA
1.9Ω	40	52	65	100	10 mA	75 mA
10Ω	18	20.5	25	33	10 mA	25 mA
19Ω	16	18.5	23	31	10 mA	25 mA
100Ω	7.5	9	11	16	10 mA	15 mA
190Ω	7	8.5	10.5	15.5	10 mA	15 mA
1 kΩ	5.5	7	8.5	13.5	700 µA	2.5 mA
1.9 kΩ	5	6.5	8	13	500 µA	2.5 mA
10 kΩ	5	6.5	8	13	50 µA	1 mA
19 kΩ	4.5	6	7.5	12.5	50 µA	1 mA
100 kΩ	6	7.5	9	14	5 µA	250 µA
190 kΩ	5.5	7	8.5	13.5	5 µA	250 µA
1 MΩ	7.5	10	11.5	19	5 µA	50 µA
1.9 MΩ	7.7	10	11.5	19	5 µA	25 µA
10 MΩ	16	24	26	50	.5 µA	5 µA
19 MΩ	20	28	30	56	.25 µA	2.5 µA
100 MΩ	65	90	120	200	.05 µA	.5 µA

** Relative to National Standards such as U.S. Bureau of Standards*

OPERATE
DANGER
HIGH VOLTAGE
LETHAL VOLTAGES MAY EXIST AT THIS OUTPUT WHENEVER INSTRUMENT IS TURNED ON. MAINTAIN CONNECTOR IN PANEL RECEPTACLE WHEN NOT IN USE.
POWER
INPUT

(NSN 6625-01-068-6762) **5205A**

5205A Precision Power Amplifier

- Extends range of 5700A, 5100 Series B, 5200A, 5440B, or 5442A Calibrators
- Output voltages to 1100V rms, ±1500V dc
- Maximum output power 220 watts
- DC to 100 kHz, typical upper limit 120 kHz
- 420 ppm midband amplitude uncertainty at 1000V rms
- 200 ppm midband six-month stability
- Fully programmable

The 5205A Precision Power Amplifier is a dc coupled programmable inverting amplifer with a fixed gain of 100. Designed as a precision calibration amplifer, the 5205A is also useful as a general-purpose amplifier for a wide range of waveforms from dc to 100 kHz. Alternating voltage output level is specified to 1100V at up to 200 mA, with a typical upper limit of 1200V before automatically tripping into standby mode. Direct voltage output level is specified to ±1500V at up to 100 mA, with a typical upper trip limit of 1600V.

The 5205A includes automatic-overload sensing and recovery. Upon sensing an excessive slew rate or frequency of the input signal, or a momentary output overload, output is returned to zero within 2 microseconds and held there for 6 milliseconds or until the fault is corrected. When a steady overload, shorted output, or excessive input drive level is detected, the 5205A trips and locks into standby mode and displays a fault indicator.

A calibrator interface is standard, including an independent input signal line. When used with a 5100 Series B, 5200A, 5440B, or 5442A Calibrator, the 5205A is controlled by the calibrator as an extension of its capabilities.

A remote control interface is also standard, and independent of the calibrator interface. This allows remote switching between the calibrator and an alternate signal input source through a front panel BNC connector.

Amplifier features of the 5205A include a gain uncertainty of as little as 0.04%, and a slew rate as high as 800 volts per microsecond.

The 5205A includes a 1-meter output cable with a protective shrouded connector. When used with a 5200A AC Calibrator, remote sensing is brought to this connection point for maximum accuracy. An insulated receptacle is provided on the front panel for safe storage of the output connector when not in use. Option 5205-07, for system applications, moves this cable and the BNC amplifier input connector to the rear panel.

All calibration adjustments and lamp replacements can be performed without exposure to high voltage. The output amplifier and all of the printed circuit modules are easily removed for repair or exchange.

Calibration and Characterization

The 5205A is calibrated at the Fluke manufacturing facility by instrumentation traceable to the U.S. National Bureau of Standards. When ordered with a 5200A AC Calibrator, 5200A-900 characterization may be ordered including simultaneous characterization of the 5205A at points compatible with 5200A-800 software. See the 5200A Alternating Voltage Calibrator for more information.

Specifications

Calibrator Mode

Amplitude Uncertainty With 5100 Series B Calibrator

Absolute Uncertainty*	
Frequency Hz	**±(ppm setting + mV)**
dc	700 + 30
50 - 10k	800 + 100
10k - 50k	1200 + 150

* *Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 20°C to 30°C, after 1-hour warm-up*

Amplitude Uncertainty With 5200A Calibrator

Basic Instrument Absolute Uncertainty*		Characterized Uncertainty**		
Freq Hz	**±(ppm setting + ppm range)**	**Freq Hz**	**±(ppm setting + ppm range)**	
			Relative	**Absolute**
10-30	1200+50	50-100	190+20	210+20
30-20k	400+20	100-10k	180+20	200+20
20k-50k	800+50	10k-20k	200+20	220+20
50k-100k	1000+100	20k-50k	310+30	630+30

* *Includes transfer standards, dc reference source, and allowances for techniques. 90 days, 18°C to 28°C, after 1-hour warm-up*

** *180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

5205A

Characterized-Point Absolute Uncertainty With 5200A:* ±ppm

Frequency, Hz							
50	100	200	1k	2k	10k	20k	50k
180	180	180	180	180	180	200	610

**Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

Amplitude Uncertainty With 5700A,5440B, or 5442A Calibrator: Use amplifier-mode gain uncertainty specifications
Output Voltage Range: 100V to 1099.999V, ±dV or rms aV
Output Voltage Resolution: 1 mV with 5200A, 5440B, or 5442A; 10 mV with 5100 Series B
Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C

Stability With 5100 Series B, 5440B, or 5442A Calibrator: Use amplifier-mode gain stability specifications

Stability With 5200A Calibrator

Frequency Hz	10 Minutes	24 Hours	6 Months
	±(ppm setting + ppm range)		
10-100	0 + 50	100 + 0	200 + 0
100-20k	70 + 5	100 + 0	200 + 0
20k-100k	70 + 5	200 + 0	400 + 0

**Constant line, load, and temperature, total peak to peak random change in rms value*

Amplifier Mode

Maximum Output Voltage: 1100V rms aV, ±1500V dV
Typical Overload Trip Voltage: 1200V rms aV, ±1600V dV
Maximum Input Voltage: 50V, dV or rms aV (without damage)
Frequency Range: 0 to 100 kHz
Typical Upper Trip Frequency: 120 kHz
Gain: X100, inverting

Gain Uncertainty

Maximum Load	DC to 20 kHz	20 kHz to 100 kHz
500Ω, 100 pF	±0.05%	±0.2%
5000Ω, 100 pF	±0.05%*	±0.15%
1 MΩ, 200 pF	±0.05%	±0.2%
1 MΩ, 500 pF	±0.06%	±0.4%
1 MΩ, 1000 pF	±0.08%	±0.8%
1 MΩ, 1500 pF	±0.1%	±1.2%

**±0.04%, dc to 10 kHz*

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add per °C below 18°C or above 28°C: dc to 20 kHz: ±(0.03 x uncertainty); 20 kHz to 100 kHz: ±(0.06 x uncertainty)

Gain Stability

Frequency Range	Max Capacitive Load	24 Hours	6 Months
dc to 20 kHz	1500 pF	0.02%	0.06%
20 to 100 kHz	100 pF	0.08%	0.2%
20 to 100 kHz	1500 pF	0.4%	0.8%

Maximum Slew Rates:*

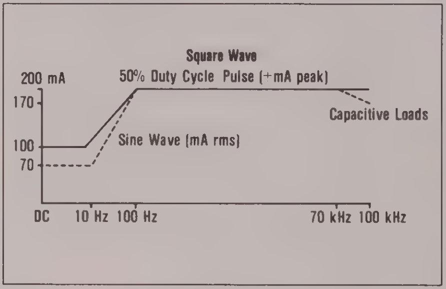
Maximum Load	Max Input Slew Rates	Max Output Slew Rates
200 mA Resistive	8.0V/µs	800V/µs
100 pF Capacitive	8.0V/µs	800V/µs
200 pF Capacitive	5.0V/µs	500V/µs
500 pF Capacitive	3.0V/µs	300V/µs
1000 pF Capacitive	2.0V/µs	200V/µs
1500 pF Capacitive	1.0V/µs	100V/µs

** Greater than 1000V output swing. Higher rates may trigger protection circuitry.*

Maximum Output Overshoot: Less than 4% of amplitude, with less than maximum input slew rate, and with greater than 1000V output swing
Maximum Isolation Voltage: Output common may be floated up to ±10V dc or rms ac from chassis to reduce common mode errors
Input Impedance: 10 kΩ in parallel with less than 120 pF
Input Connector: BNC, located on front panel. (Located on rear panel with Option -07)
Maximum Input Voltage: 50V dV or rms aV
Maximum Input Bias Current: 100 nA

General Specifications

Maximum Load Current: Bipolar symmetrical waveforms



Unipolar Rectangular Waveform:* ±200 mA peak with pulse width less than 5 msec; period greater than 10 msec.
Linearly derating to: ±100 mA peak with pulse width greater than 50 msec; period less than 100 msec

** Referenced to zero volts. Under all circumstances, output current capability is at least ±100 mA peak*

Maximum Capacitive Load: 1500 pF, not to exceed rated load current. (Example: maximum capacitive load at 1000V, 100 kHz is 270 pF
DC Offset Voltage: ±10 mV at the output*

**90 days, 18°C to 28°C, after 1-hour warm-up*

Total Harmonic Distortion:* Resistive loads greater than 1500Ω or capacitive loads less than 1000 pF

10 Hz to 20 kHz	0.05% of setting
20 kHz to 50 kHz	0.07% of setting
50 kHz to 100 kHz	0.1% of setting

Resistive loads less than 1500Ω or capacitive loads greater than 1000 pF

10 Hz to 10 kHz	0.05% of setting
10 kHz to 20 kHz	0.1% of setting
20 kHz to 50 kHz	0.17% of setting
50 kHz to 100 kHz	0.25% of setting

**Bandwidth 10 Hz to 1 MHz*

Overload Protection: Limit protection against input noise spikes, momentary output over loads, excessive input slew rate, and excessive input frequency. Trip protection against input overdrive, steady overloads, and short circuit.
Random Noise: Less than 100 mV rms, 1 MHz bandwidth
Line-Related Noise: Less than 50 mV rms
Line Regulation: ±10 ppm of setting for 10% change in line voltage
Input Power: 100V, 115V, 200V, 230V ac, ±10%, internal jumper selected, 50 Hz to 60 Hz, 1800 VA at full load. Receptacle on rear panel for calibrator power
Size: 26.7 cm H x 43.2 cm W x 62.7 cm D (10.5 in H x 17 in W x 24.7 in D)
Weight: 54.5 kg (120 lb)
Included: Instruction Manual, interface cable to 5200A, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

5205A Precision Power Amplifier	$10,450
5205A-07 With Rear Input/Output	10,470

Accessories (Also see page 485)

Y5000 Interface Buffer for 5100 Series	600
Y5001 Interface Cable for 5100 Series, 5440B, or 5442A	275
M10-205-600 Rack Mount Kit for 5205A	110
M00-280-610 24" Rack Slides for rack adapter	130

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

POWER
OFF ON
OUTPUT LOW
DANGER
HIGH VOLTAGE
LETHAL VOLTAGES MAY EXIST AT THIS OUTPUT WHENEVER INSTRUMENT IS TURNED ON. MAINTAIN CONNECTOR IN PANEL RECEPTACLE WHEN NOT IN USE
INSTRUMENT ON
DANGER 1200 Vrms

NSN 5895-01-088-8715 **5215A**

5215A Precision Power Amplifier

- Designed for use with 5700A, 5200A, or 5100B Calibrators
- Output voltages to 1100V rms
- Maximum output power 220 watts
- 10 Hz to 100 kHz, typical upper limit 120 kHz
- 420 ppm midband amplitude uncertainty at 1000V rms
- 200 ppm midband six-month stability
- Fully programmable
- Short and overload protected

The 5215A Precision Power Amplifier is an ac coupled programmable inverting amplifer with a fixed gain of 100. Output level is specified to 1100V at up to 200 mA, with a typical upper limit of 1200V before automatically tripping into standby mode.

The 5215A includes automatic-overload sensing and recovery. Upon sensing an excessive slew rate or frequency of the input signal, or a momentary output overload, output is returned to zero within 2 microseconds and held there for 6 milliseconds or until the fault is corrected. When a steady overload, shorted output, or excessive input drive level is detected, the 5215A trips and locks into standby mode and displays a fault indicator.

An interface for a 5200A Alternating Voltage Calibrator is standard, allowing the 5215A to be controlled by the calibrator as an extension of its capabilities.

The 5215A includes a 1-meter output cable with a protective shrouded connector. Remote sensing is brought to this connection point for maximum accuracy. An insulated receptacle is provided on the front panel for safe storage of the output connector when not in use. Option 5215-07, for system applications, moves this cable to the rear panel.

All calibration adjustments and lamp replacements can be performed without exposure to high voltage. The output amplifier and all of the printed circuit modules are easily removed for repair or exchange.

Calibration and Characterization

The 5215A is calibrated at the Fluke manufacturing facility by instrumentation traceable to the U.S. National Bureau of Standards. When ordered with a 5200A AC Calibrator, 5200A-900 characterization may be ordered including simultaneous characterization of the 5215A at points compatible with 5200A-800 software. See the 5200A Alternating Voltage Calibrator for more information.

Specifications

Amplitude Uncertainty With 5200A Calibrator

Basic Instrument Absolute Uncertainty*		Characterized Uncertainty**		
Freq Hz	±(ppm setting + ppm range)	Freq Hz	±(ppm setting + ppm range)	
			Relative	Absolute
10-30	1200+50	50-100	190+20	210+20
30-20k	400+20	100-10k	180+20	200+20
20k-50k	800+50	10k-20k	200+20	220+20
50k-100k	1000+100	20k-50k	310+30	630+30

** Includes transfer standards, dc reference source, and allowances for techniques. 90 days, 18°C to 28°C, after 1-hour warm-up*

*** 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

Characterized-Point Absolute Uncertainty:* ±ppm

Frequency, Hz							
50	100	200	1k	2k	10k	20k	50k
180	180	180	180	180	180	200	610

**Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

Output Voltage Range: 100V to 1099.999Vrms
Output Voltage Resolution: 1 mV with 5200A; 10 mV with 5100 Series, ac output only
Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C

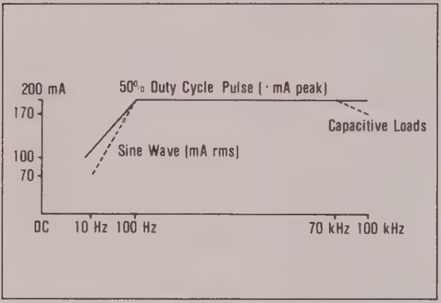
Stability

Frequency Hz	10 Minutes	24 Hours	6 Months
	±(ppm setting + ppm range)		
10-100	0 + 50	100 + 0	200 + 0
100-20k	70 + 5	100 + 0	200 + 0
20k-100k	70 + 5	200 + 0	400 + 0

**Constant line, load, and temperature, total peak to peak random change in rms value*

Maximum Isolation Voltage: Output common may be floated up to ±10V dc or rms ac from chassis to reduce common mode errors

Maximum Load Current:



Maximum Capacitive Load: 1500 pF, not to exceed rated load current. (Example: maximum capacitive load at 1000V, 100 kHz is 270 pF

DC Offset Voltage: ±10 mV at the output*

**90 days, 18°C to 28°C, after 1-hour warm-up*

Total Harmonic Distortion:* Resistive loads greater than 1500Ω or capacitive loads less than 1000 pF

10 Hz to 20 kHz	0.05% of setting
20 kHz to 50 kHz	0.07% of setting
50 kHz to 100 kHz	0.1% of setting

Resistive loads less than 1500Ω or capacitive loads greater than 1000 pF

10 Hz to 10 kHz	0.05% of setting
10 kHz to 20 kHz	0.1% of setting
20 kHz to 50 kHz	0.17% of setting
50 kHz to 100 kHz	0.25% of setting

**Bandwidth 10 Hz to 1 MHz*

Overload Protection: Limit protection against input noise spikes, momentary output over loads, excessive input slew rate, and excessive input frequency. Trip protection against input overdrive, steady overloads, and short circuit.

Random Noise: Less than 50 mV rms

Line Regulation: ±10 ppm of setting for 10% change in line voltage

Input Power: 100V, 115V, 200V, 230V ac, ±10%, internal jumper selected, 50 Hz to 60 Hz, 1800 VA at full load. Receptacle on rear panel for calibrator power

Size: 26.7 cm H x 43.2 cm W x 62.7 cm D (10.5 in H x 17 in W x 24.7 in D)

Weight: 54.5 kg (120 lb)

Included: Instruction Manual, interface cable to 5200A, power cords, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

5215A Precision Power Amplifier	$9750
5215A-07 With Rear Output	9770

Accessories (Also see page 485)

M10-205-600 Rack Mount Kit for 5205A	110
M00-280-610 24" Rack Slides for rack adapter	130

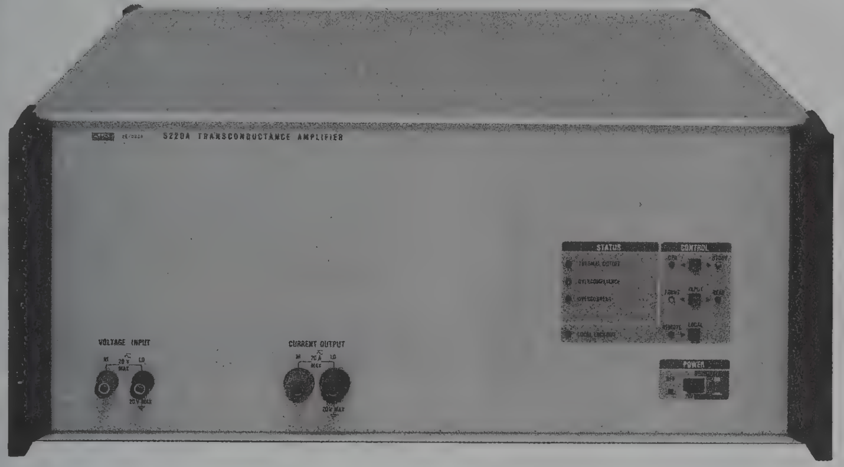
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-5215A Repair (w/calibration)	772
SC1-5215A Repair (cal w/in or out data)	847
SC1-5215A Repair (cal w/in and out data)	922
SC2-5215A Cal	462
SC2-5215A Cal (w/in or out data)	612
SC2-5215A Cal (w/in & out data)	762



(NSN 6625-01-083-3801) **5220A**

5220A Transconductance Amplifier

- 20 amps output dc or rms ac
- 0.025% basic dc accuracy
- Over-voltage and over-current protection
- Over-temperature protection
- May be programmed through the 5100 Series B

The 5220A Transconductance Amplifier lets you calibrate alternating or direct current meters and shunts and the current functions of digital multimeters that measure up to 20A. A known input voltage of 1 to 20 volts produces a known output current of 1 to 20A.

The 5220A is designed to be controlled by the 5100 Series B Calibrators but may be driven by another voltage source such as the 5200A. When used with a 5100 Series B, the current range of those instruments is extended by a factor of 10 to 1. Options are available for the 5100 Series B that make the system IEEE-488 and RS-232-C compatible.

Built-in Protection

Protection is designed in to eliminate problems caused by excessive inputs, open inputs, and overcompliance. Indicators on the front panel tell the user about any of these conditions. Automatic shut down occurs should the internal temperature rise excessively.

The Y5000 Interface/Buffer

Drive voltage to the 5220A may be introduced through the front panel or the rear panel. The connector on the rear, however, allows the 5220A to work with a 5100B (or 5101B) Calibrator through an Interface/Buffer (Y5000) and cable that attaches to the rear panels.

With the Y5000 Interface/Buffer, the two instruments operate as one integrated calibration system with all the advantages of single control-point calibration; automatic error calculation, entry limit protection, etc.

A single Y5000 Interface/Buffer may be used to control and operate both a 5220A Transconductance Amplifier and a 5205A Power Amplifier from a 5100 Series Calibrator.

Specifications

The specifications below apply for 180 days for instruments operated between 20°C and 30°C in a relative humidity of 70% or less.

Transconductance: 1 siemens (1 ampere per volt)

Output Range: 0 to 20A dc or rms ac (28.3A peak)

Maximum Compliance Voltage: ≥±4V dc, or 3V rms ac (4.25V peak)

DC Accuracy: ±(0.025% of output +1 mA)

AC Accuracy: ±(0.05% of output +1 mA) from 30 Hz to 1 kHz, and ±(0.05% of output +1 mA) x f from 1 kHz to 5 kHz, where f = frequency in kHz

Short Term DC Stability: Output changes less than ±(0.005% + 200 μA) in 10 minutes, with constant line, load, and temperature

Short Term AC Stability: Output changes less than ±(0.01% + 500 μA) in 10 minutes, with constant line, load, and temperature

Harmonic Distortion and Noise: ±(0.05% of output ±1 mA) over frequency range of 30 Hz to 1 kHz and measured with a noise bandwidth of 300 kHz, ±0.05% of output +1 mA) x f from 1 kHz to 5 kHz, where f = frequency in kHz

Temperature Coefficient: ±(0.0025% of output +100 μA) per degree C, above 30°C or below 20°C

Transient Recovery: Output will settle to within 0.01% of final value within 2 seconds following a programmed change in output current or frequency (10 ms for 5220A alone)

Load Capability: Drives all resistive and capacitive loads consistent with current and compliance voltage capability. Drives inductive loads (with reduced accuracy) up to 200 microhenries, consistent with current and compliance voltage capability

Maximum Isolation Voltage: ±20V dc or 20V ac rms

Temperature Range: 0°C to 50°C (operating) and -20°C to 65°C non-operating

Relative Humidity: ≤50% to 50°C, ≤75% to 40°C, ≤95% to 25°C

Altitude: 0 to 10,000 feet (operating) and 0 to 40,000 feet (non-operating)

Vibration: 2G maximum, 5 Hz to 55 Hz for 15 minutes

Shock: 15G maximum, half sinewaves

Power: 100, 110, 115, 120, 200, 220, 230, or 240V ac +10%, switch-selectable, 50 Hz to 60 Hz, 300 watts

Size: 17.8 cm H x 43.2 cm W x 55.9 cm D (7 in H x 17 in W x 22 in D), case only

Weight: 227 kg (50 lb)

Included: Manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

5220A Transconductance Amplifier	$5650

Accessories (Also see page 485)

Y5020 Current Shunt	700
Y5000* Interface/Buffer	600
Y5002* Cable (Y5000 to 5220A)	240
M00-270-610 20" Slides for Rack Adapter	130
M00-280-610 24" Slides for Rack Adapter	130

**Required when controlled from 5100B or 5101B*

335A & 335D

(NSN 6625-00-445-3328) **335A**

335A & 335D DC Voltage Calibrators/Null Detectors

- 0 to 1100V output, 0 to 50 mA
- 0.1 ppm resolution, seven decades
- Built-in null detector for differential voltage measurements
- 10 ppm basic accuracy (335D)
- 5 ppm basic stability per month (335D)
- Overvoltage and overcurrent protection

Combining accuracy with versatility, Models 335A and 335D provide the functions of a precision dc voltage standard with those of a differential voltmeter and high impedance null detector. The only practical difference between the 335A and the 335D is their accuracy and stability.

Both instruments provide 0.1 ppm resolution, using seven in-line decade switches.

Specifications

Voltage Ranges: 10, 100, and 1000V with out puts as follows: 0 to 11.111110 (1 µV steps), 0 to 111.111110 (10 µV steps), 0 to 1111.1110 (100 µV steps)

Output Current: 0 to 50 mA

Accuracy of Output:* ±(% of Setting + µV)

Range	335A, 90 Days	335D, 60 Days
10V	0.002 + 10	0.001 + 10
100V	0.002 + 20	0.001 + 20
1000V	0.002 + 200	0.0015 + 200

*Also measurement accuracy of 335A and 335D used as a differential voltmeter

NOTE: Accuracy is absolute, relative to NBS standards, and include effects of stability, line regulation, and calibration uncertainties under standard reference conditions of 23°C ± 1°C and up to 70% relative humidity.

Stability of Output: ±(% of Setting + µV)

Range	335A	335D
10V	±(0.001 + 10)/mo ±(0.002 + 20)/yr	±(0.0005 + 7)/mo —
100V & 1000V	±(0.001 + 20)/mo ±(0.002 + 40)/yr	±(0.0005 + 30)/mo —

Temperature Coefficient: (0.0002% of setting +1 µV)/°C from 22°C to 0°C or 24°C to 50°C

Overcurrent Protection: Limits current at 1 mA to 60 mA via continuously variable front panel control

Overvoltage Protection: Trips output if voltage level exceeds setting of front panel controls. Continuously variable from 10% to 110% of each range

Ripple and Noise: 10V range, ≤20 µV rms; 100V range, ≤30 µV rms; 1000V range, ≤40 µV rms

Settling Time: Typically within 10 ppm of final output less than 20s after a range change

Regulation: 0.0002% of setting or 10 µV for a 10% line voltage change or a full load change

Common Mode Noise Rejection: ≥140 dB from dc to 400 Hz, up to 700V rms or 1000 dV

Isolation: Either output terminal may be floated up to 1000 dV from chassis ground

Remote Sense: Separate terminals are provided for sensing the output voltage directly at the load

Temperature: 0°C to 50°C, operating

Power: 115 or 230V ac ±10%, 40 to 60 Hz, approximately 130 VA fully loaded

Size: 17.8 cm H x 48.2 cm W x 45.7 cm D (7 in H x 19 in W x 18 in D)

Weight: 23 kg (50 lb)

Mounting: Standard 19" EIA relay rack, tapped for attachment of slides; resilient feet provided for bench use

Included: Manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

335A DC Voltage Calibrator/ Null Detector	$11,450
335D DC Voltage Calibrator/Null Detector (NSN 6625-00-361-5246)	11,950

Accessories (Also see page 485)

A60-01 17-20" Rack Slides	on req

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-335A Repair (w/ calibration)	557
SC1-335A Repair (cal w/in or out data)	632
SC1-335A Repair (cal w/in and out data)	707
SC2-335A Cal	596
SC2-335A Cal (w/in or out data)	896
SC2-335A Cal (w/in & out data)	1196
SC1-335D Repair (w/ calibration)	658
SC1-335D Repair (cal w/in or out data)	733
SC1-335D Repair (cal w/in and out data)	808
SC2-335D Cal	596
SC2-335D Cal (w/in or out data)	896
SC2-335D Cal (w/in & out data)	1196

343A

(NSN 6625-00-238-1283) **343A**

343A DC Voltage Calibrator

- 0 to 1100V output, 0 to 25 mA
- 0.1 ppm resolution, seven decades
- 20 ppm basic accuracy
- Stability better than 5 ppm/hour, 15 ppm/month

The 343A is a 7-digit instrument with a basic accuracy of 20 ppm and a resolution of 1 µV on the 10 µV range.

Cleanliness of the dc output is evident in the combined ripple and noise specifications of 50 µV rms from the 343A. Short term jitter and other random excursions are almost non-existent, less than 1 ppm.

A simple amplifier/comparator circuit is utilized to establish a convenient, variable, current limiter. Any maximum current output from 1 to 30 mA may be set via a front panel control. In addition to providing for current protection to the load, a failsafe "crowbar" protects the series-pass elements from damage should the total voltage across the elements exceed a safe level.

Specifications

Output Voltage: 0 to 1100 dV
Resolution: 1 µV on 10V range, 10 µV on 100V range, 100 µV on 1000V range

Accuracy, 90 Days
10V Range: ±0.002% of setting or ±0.0002% of range*
100V Range: ±0.002% of setting or ±0.0001% of range*
1000V Range: Same as 100V range

**Whichever is greater*

NOTE: The above accuracies are absolute, relative to NBS standards, and include effects of stability, line regulation, load regulation, and calibration uncertainties under standard reference conditions of 23°C ±1°C and up to 70% relative humidity after 30 minute warm-up. Apply for 90 days.

Stability: ±% of Setting or ±Microvolts*

Time	10V Range	100V Range	1000V Range
Per Hour	0.005% or 5 µV	0.0005% or 10 µV	0.0005% or 20 µV
Per Month	0.0015% or 15 µV	0.0015% or 25 µV	0.0015% or 50 µV
Per 6 Months	0.0025% or 30 µV	0.0025% or 40 µV	0.0025% or 60 µV

**Whichever is greater*

Temperature Coefficient: ±(3 ppm of setting +0.1 ppm of range +2 µV) per degree Celsius from 24°C to 15°C or 25°C to 35°C
Regulation: <0.0005% of setting +25 µV for a 10% line voltage change or a full-load to no-load change
Isolation: May be floated 500 dV from chassis
Settling Time: Within 15 ppm of final output in 5 seconds
Overcurrent Protection: Automatically limits output current at any preset level between 1 mA and 30 mA via continuously variable front panel control. Panel lamp illuminates during limiting
Meter: Switch-selectable to full range voltage or full range current
Remote Sense: Separate terminals are provided for sensing the output voltage directly at the load
Temperature: 0°C to 50°C, operating
Power: 115 or 230V ac ±10%, 50 to 440 Hz, approximately 60 VA fully loaded
Size: 8.9 cm H x 43.2 cm W x 45.7 cm D (3.5 in H x 17 in W x 18 in D)
Weight: 10.43 kg (23 lb)
Included: Instruction Manual, power cord, serialized and dated calibration certificate

Ordering Information

Model

January 1989 prices

343A DC Voltage Calibrator	$5950

Accessories (Also see page 485)

MEE-7001 3" Rack Adapter	120
MEE-8078 24" Rack Slides for rack adapter	140
MEE-8079 18" Rack Slides for rack adapter	150

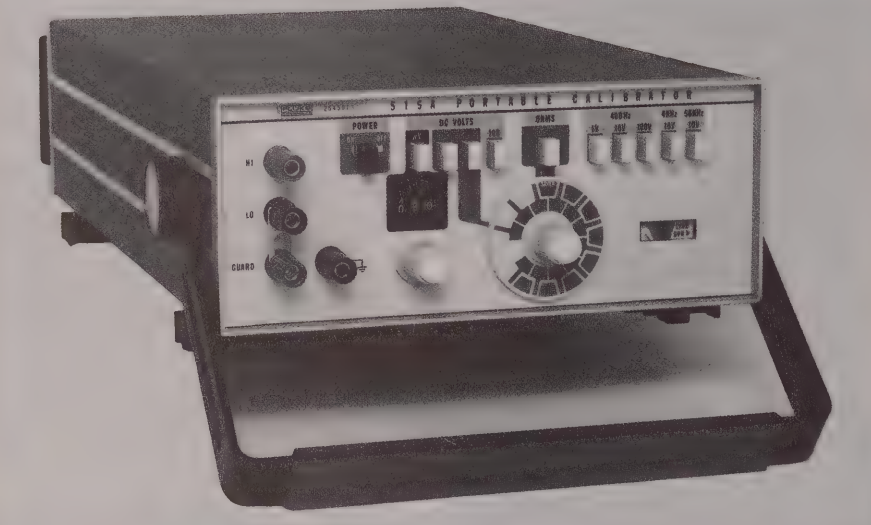
Service & Support

Warranty
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-343A Repair (w/calibration)	231
SC1-343A Repair (cal w/in or out data)	306
SC1-343A Repair (cal w/in and out data)	381
SC2-343A Cal	252
SC2-343A Cal (w/in or out data)	402
SC2-343A Cal (w/in & out data)	552

515A



(NSN 6625-01-086-204) **515A**

515A Portable Calibrator

- Precision, portable, 4-1/2 digit calibration and 5-1/2 digit verification where you need it
- Battery powered when disconnected from line power
- Lightweight and small size

The Model 515A Portable Calibrator is a precision voltage and resistance calibration source for on-site calibration of measuring instruments. The 515A provides direct and alternating voltage and resistance standards in a unit only 3-1/2 inches high by 8-1/2 inches wide by 16 inches deep. The instrument weighs just 13 pounds, including the rechargeable battery pack, which eliminates warm-up delays after transit and allows 8-hour operation free of line power for true portability. The 515A's basic uncertainty is specified over a temperature range of 18°C to 28°C for a 1-year period, thus making it easy to use in production test and calibration environments without complex correction terms. The long calibration cycle also makes the 515A economical to own by minimizing maintenance overhead costs.

All 515A outputs are available at a single set of output terminals. In addition, terminals are available to allow guarding and shielding of test leads in critical test situations.

If the unit is connected to the ac line, the internal battery is placed on charge; otherwise the 515A automatically operates from the battery and its state of charge is indicated on the meter to the right of the panel.

The 515A can be used effectively to test a wide range of characteristics in measuring instruments. Here are a few of the many applications:

dV: Input offset current, a/d linearity, absolute accuracy

aV: Frequency response, converter linearity, residual noise, absolute accuracy

Resistance: Linearity, residual resistance, absolute accuracy

General: Zero offset and stability, autoranging, overranging

Specifications

Technical Specifications

Direct Voltage

Ranges

μV: 0 to 99 μV continuous (0.2 μV resolution)
1V: 0 to 1.0V in 0.1V steps
10V: 0 to 10V in 1V steps
100V: 100V cardinal point

Accuracy: (For 1 year, 18°C to 28°C, 30 min warm-up)

μV range: ±2 μV
1V, 10V, and 100V ranges: ±30 ppm or 30 μV of range, whichever is greater

Output Current: Function of source resistance, except 100V range which is limited at approximately 0.5 mA. No damage to instrument with short circuit on output.

Source Resistance

μV, 1V, 10V ranges: 300Ω
100V range: <1Ω (up to 0.5 mA load)

Alternating Voltage

Range: 1V, 10V, 100V cardinal points

Output Frequencies

10V: 400 Hz, 4 kHz, 50 kHz
1V, 100V: 400 Hz

Accuracy: (For 1 year, 18°C to 28°C, 30 min warm-up)

1V: ±0.05%
10V: ±0.04% at 400 Hz and 4 kHz. ±0.1% at 50 kHz
100V: ±0.06%

Frequency Accuracy: ±1% except at 50 kHz ±5%

Total Harmonic Distortion and Noise: <0.03% (400 Hz and 4 kHz), <0.05% (50 kHz)

Output Current

1V, 10V output: 0 to 10 mA rms
100V output: 0 to 0.5 mA rms

Resistance

Range: 10Ω through 10 MΩ in decade steps + zero setting

Accuracy: (1 year, 18°C to 28°C, referred to "0"Ω position)

0Ω - Residual resistance is less than 0.15Ω
10Ω - 100Ω: ±0.06%
1 kΩ- 1 MΩ: ±0.015%
10 MΩ: ±0.075%

Power Rating: 0.2W or 100V (dc or rms), whichever is less

General Specifications

Temperature: 0°C to 50°C, operating

Power: 100, 115, 200, 230V ac, ±10%, 50 to 440 Hz, <10W, or internal batteries. Eight hours operation from batteries when fully charged

Weight: 5.9 kg (13 lb)

Size: 8.9 cm H x 21.6 cm W x 40.6 cm D (3.5 in H x 8.5 in W x 16 in D)

Included: Manual, power cord, batteries, serialized and dated calibration certificate

Ordering Information

Model	January 1989 prices
515A Calibrator	$4695

Accessories (Also see page 485)

M03-200-618 3" Rack Adapter, Dual	75
M03-200-619 3" Rack Adapter, Single, Offset	105
M03-200-620 Panel Mounting Kit	60
M03-203-700 Panel Protector	26

Y5020

Y5020 AC or DC Current Shunt

- Rated to 20A dc to 5 kHz
- 100 ppm uncertainty
- 10 milliohms nominal resistance
- Less than 250 mV burden

The Y5020 Current Shunt is a very stable, non-inductive, four-terminal resistive current shunt. It may be used to verify the accuracy of the 5220A Transconductance Amplifier or other current calibrators. It is an inexpensive method of accurately measuring current up to 20 amperes, from dc to 5 kHz. The 0.01Ω nominal resistance creates less than 250 mV burden. A forced-air cooling fan stabilizes internal ambient temperature during use.

Specifications

The following specifications apply for one year, provided the Y5020 is operated with its cooling fan in ambient temperatures from 18°C to 28°C. Voltage terminals must be connected to a measurement circuit with an input resistance of 1 MΩ or greater and a capacitance of 500 pf or less.

Nominal Resistance: 0.01Ω ±1%
Uncertainty:* Direct current, ±100 ppm; alternating current, ±(150 ppm + 120 ppm x frequency in kHz) relative to direct current specification
** Referenced to the certified absolute value of shunt resistance stamped on the front panel*
Stability: Less than 20 ppm resistance change in six months
Maximum Current: 20A direct current or rms aternating current
Burden Voltage: Less than 250 mV at 20A
Temperature Coefficient: Less than 20 ppm/°C; 0°C to 18°C and 28°C to 50°C
Power Coefficient: Less than 12 ppm per watt
Operating Temperature: 0°C to 50°C ambient
Storage Temperature: -40°C to 70°C
Input Power:* 115V or 230V ac ±10%, 11 watts
Size: 12.7 cm H x 20.5 cm W x 3.6 cm D (5.0 in H x 8.0 in W x 12.9 in D)
Included: Instruction sheet
** For cooling fan. Specify 115V or 230V when ordering*

Ordering Information

Model	January 1989 prices
Y5020* Current Shunt	$700

**Specify supply voltage (e.g., Y5020-115 or Y5020-230)*

Service & Support

Warranty

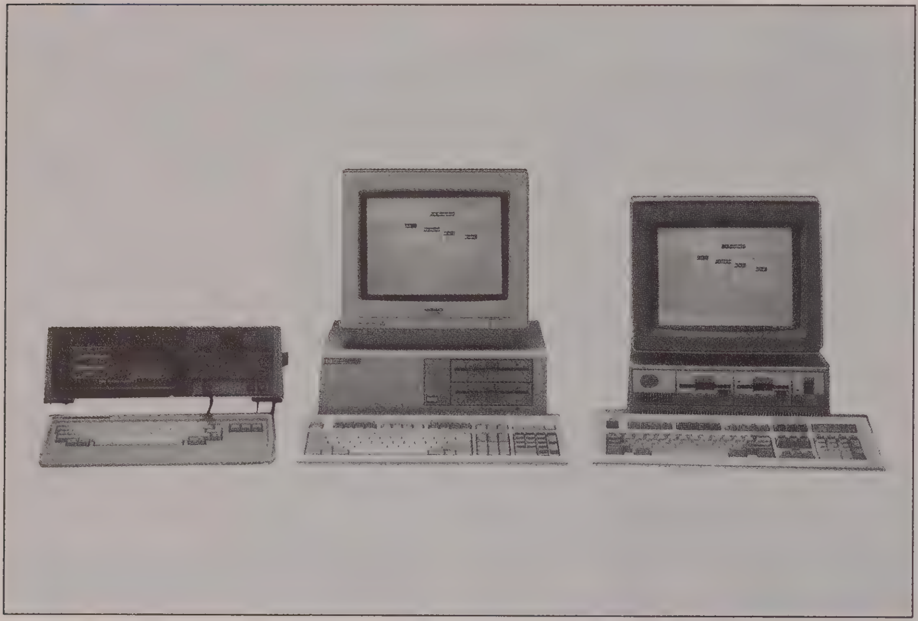
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-Y5020 Repair (w/calibration)	43
SC1-Y5020 Repair (cal w/in or out data)	78
SC1-Y5020 Repair (cal w/in and out data)	113
SC2-Y5020 Cal	104
SC2-Y5020 Cal (w/in or out data)	139
SC2-Y5020 Cal (w/in and out data)	174

Introduction

NEW



Fluke Calibration Systems and Software

- **New**
  - Personal Computers as System Controllers With:
    - True GPIB SRQ Interrupt Handlers
    - Near Photo Quality Color Graphics
    - On-Line Help Screens
    - Full Screen Procedure Editor
  - SDF Compatible Traceability Files in all Software
  - SDF Compatible Test Report Header Data File
  - Customized Test Report Header Format
  - Fluke 5700A and 8842A in Systems
  - High Accuracy Meter Calibration Systems
  - Lab-Cart based Mobile Calibration
- **Improved**
  - Procedure Editing
  - GPIB I/O for Closed Loop Calibration
  - Test Results Data Formatting and Pagination

Experience counts

Automating the calibration lab is no simple task. Many questions arise. Will the system you choose meet all of your workload requirements? Can it be integrated with other systems now or in the future? Will you be able to use all the capabilities of the instruments in the system? Will it meet your reporting needs? How difficult will it be to write or edit procedures and will they be compatible with the way your lab operates? Will your non-technical personnel be able to use the system effectively? Is the system software in wide use, with strong vendor support and continuous improvements.

At Fluke, we have been building automated calibration systems for more than 15 years. We understand your needs. And we know what it takes to meet them. That's why more labs automate the calibration of dc and low frequency ac test and measurement instruments with Fluke systems than any other.

Fluke Software. The heart of your automated system.

An automated calibration system is no better than its software. Software impacts everything from who can use the system to the workload it can process.

At the heart of every Fluke automated calibration system is Fluke software, designed by calibration professionals specifically for people who work in calibration labs.

Fluke software is designed to control all the functions and capabilities of a very broad selection of calibration instruments. So you can choose the tools that cover your workload now, and add to your system later as your workload changes.

With Fluke calibration software, you don't need to be a computer programmer to generate calibration procedures. A familiar, procedure-oriented language makes generating procedures easy. Plus, Fluke offers example procedures that will give you a head start at writing your own.

It's easy to select a system that fits both your workload and your budget.

Fluke automated systems give you flexibility in matching your calibration workload to your budget. You have a choice of controllers, DMM and oscilloscope calibrators, packaging and an extensive selection of auxiliary instruments. You can start small and add or change instruments as your workload needs change. Fluke makes it easy.

We stand behind every system we sell.

With Fluke support, you leave nothing to chance. We can help you design your system. When it's complete, a Fluke application engineer will install and test it, and will work with you and your technicians to get your system up and running fast.

So that you can get the maximum out of your system and the instruments in it, Fluke also offers a wide range of maintenance, procedure writing, metrology and lab management training courses. These courses are held regularly at selected Fluke Service Centers. For groups up to eight, we can bring a course to your site.

Why automate?

The calibration process typically includes several steps that are ideally suited to automation. You need to locate and recall an instrument, consult the manual for its calibration procedures and specifications, verify and adjust the instrument, record results, generate reports and calibration certificates, and return the instrument to the user.

It's time consuming. At every step of the way, the potential for errors is considerable. And the longer the process takes, the longer an instrument is kept out of the hands of its owner.

Automation increases your lab's throughput and productivity.

Operating a Fluke automated calibration system is simple for technicians of all skill levels. Clear, plain-language instructions and illustrations prompt the user through each step of the process. Even entry level technicians can calibrate complicated instruments confidently and efficiently.

Because the procedure is in software, there is no need to consult a manual. And results information is automatically recorded as a matter of course.

For modern instruments with an IEEE-488 interface and software calibration capability, the system can perform the calibration "closed loop, closed case" very quickly, with little intervention by the operator.

Finally, Fluke automated calibration systems make fast work of verifying and adjusting the instrument. Your lab can process more work in less time, so downtime due to calibration recall is reduced.

Automation enhances the quality and consistency of your calibrations.

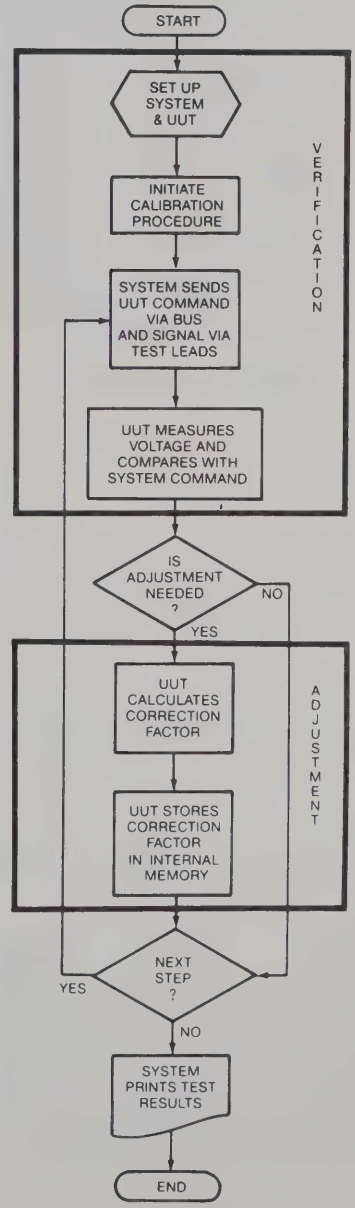
Because calibration procedures run under the control of the system controller, each one is run the same way every time in every location where it is used. Decisions about what function to verify, when to perform a task and whether or not a reading is within tolerance, are made within the system, rather than by the operator. And because you write the procedure, it reflects your calibration philosophy and practice.

Automation streamlines your data management tasks.

Recording and reporting information is one of the most time-consuming phases of the calibration process. Yet it is critical to maintaining the traceability of your lab.

Because your procedures are stored by the system controller, you have a complete record of how your instruments are verified. Fluke calibration software also automatically records results information about every instrument you calibrate. In fact, Fluke software even maintains traceability information about the calibration instruments in the system. And that information can be reported in a variety of formats, as your requirements dictate. Or you can analyze the information off-line to determine instrument performance trends or to establish efficient recall schedules.

How Does Closed-Loop Calibration Work?


START
SET UP SYSTEM & UUT
INITIATE CALIBRATION PROCEDURE
SYSTEM SENDS UUT COMMAND VIA BUS AND SIGNAL VIA TEST LEADS
UUT MEASURES VOLTAGE AND COMPARES WITH SYSTEM COMMAND
VERIFICATION
IS ADJUSTMENT NEEDED ?
NO
YES
UUT CALCULATES CORRECTION FACTOR
UUT STORES CORRECTION FACTOR IN INTERNAL MEMORY
ADJUSTMENT
NEXT STEP ?
YES
NO
SYSTEM PRINTS TEST RESULTS
END

Fluke 7411 Series Calibration Software.

Software is the heart of any automated calibration system. Any system is only as fast, as capable or as easy to use as its software.

Fluke 7411 Series Calibration Software represents more than 15 years of experience in automating the cal lab. It is designed to be used by calibration technicians, not computer programmers. And its capabilities are driven by your need for workload coverage, flexibility and calibration data acquisition.

In addition to permitting you flexibility in the calibration instruments you choose for your system, Fluke 7411 Series Calibration Software offers you a choice in system controllers: the Fluke 1722A Touch Screen Instrument Controller, Hewlett Packard Vectra ES12 or IBM PS/2 Model 50.

Users who are familiar with earlier versions of 7411 Software for the Fluke 1722A Controller will be able to use 7411PC with little or no training. 7411B procedures are upward compatible with 7411PC with the use of a translator utility.

A comparison of the Fluke 1722A Instrument Controller, HP Vectra ES12 and IBM PS/2 Model 50 in an automated calibration system.

	Fluke 1722A	HP Vectra	PS/2-50
SRM Access Possible	No	Yes	No
3rd Party Software Available	Limited	Yes	Yes
Operator Interface	Touch Sense Monitor Operators' Aid standard	Keyboard Operators' Aid optional	Keyboard Operators' Aid optional
Rack Mount Monitor	Yes	No	No
Monitor	Mono.	Color	Color
Hard Disk	External	Internal	Internal
Direct Network Compatibility	No	Yes	Yes
Ruggedness	Excellent	Good	Good

Simple procedure generation.

When you sit down to write a calibration procedure, you use calibration oriented Function Selection Codes (FSCs). You then enter the procedural data that will be used by the FSC in carrying out the function. For example, for FSCs that select a calibrator, the relevant procedural data would specify such factors as the output and tolerance. There is no need to generate cumbersome flow charts or intermediate code before you can use your procedure.

No programming. FSCs save you time by condensing multiple programming instructions into a single, easily recognizable selection. Typically, these are either instrument model numbers (5700) or English words (EVALuate). FSCs eliminate the programming knowledge usually necessary to perform complex tasks. With 7411 Series Calibration Software, you simply select the FSC you want and insert the appropriate calibration parameters. The software does the rest.

Automatic procedure checking. While you are writing a procedure, the calibration software checks it for accuracy. For example, it compares the outputs you specify with the capabilities of the calibrator used and alerts you if a command is outside the calibrator's range.

Example procedures. When you purchase 7411 Series Calibration Software, you get a set of example procedures at no extra cost. You can use these procedures in their existing form, or edit them as required to fit your equipment configuration, your cal lab philosophy or other factors specific to your application.

Example Procedures

METERS	7411C and 7411PC	
	Verification	Adjustment
Fluke		
21	•	•
23	•	•
25	•	•
37	•	•
73	•	•
75	•	•
77	•	•
8000A	•	•
8020B	•	•
8021A	•	•
8022A	•	•
8024A	•	•
8026A	•	•
8050A	•	•
8060A	•	•
8840A	•	•
Hewlett-Packard		
3478A	•	•
OSCILLOSCOPES		
Hewlett-Packard		
182A	•	
1801A	•	
1820B	•	
Tektronix		
465A	•	•
2215A	•	

Simple operation.

When you run a calibration procedure on a Fluke automated calibration system, the software does the hard work. It not only leads the operator through the procedure itself, but also handles many of the tasks that are usually done by the operator — from taking the measurements to calculating and recording the error of the unit under test.

Automated calibration. For the calibration of instruments that do not have an IEEE-488 interface, the software guides the operator through the procedure and performs the necessary calculations, helping the operator to make the actual changes to the unit.

Once the calibration procedure has been loaded, step-by-step instructions and graphics on the controller's display guide the operator through each task, allowing even inexperienced operators to perform complex calibration procedures with very little training. In addition, this close guidance assures you that calibration procedures are followed to the letter.

Closed-loop calibration. If the instrument to be calibrated has an IEEE-488 interface, you can save even more time by performing closed-loop calibration.

Closed-loop calibration begins with the operator identifying the unit to be calibrated and the system loading the appropriate procedure. The system then prompts the operator to connect the necessary test leads, sets the unit to the proper range and function, applies the calibrated output from the calibration instruments, evaluates the unit's reading, then proceeds to the next step until the unit has been completely verified with little or no operator intervention.

If the unit under test is capable of software adjustment, like the Fluke 8840 Series DMMs, the system can also make the necessary adjustments by storing correction factors in the unit's non-volatile memory. Otherwise, the system advises the operator of the necessary adjustments. Because of its graphics capability, procedures in Fluke calibration software can incorporate illustrations where necessary to show the operator where to make connections or adjustments.

Flexible Test Reporting

When the calibration procedure is completed, the cal results data is available in printouts with user-defined headers. In addition, a test summary and traceability data are available in a Standard Data Format (SDF) delimited file for use with your data management software.

A comparison of Fluke 7411C and 7411PC Software

Feature	7411C	7411PC
Runs on the Fluke 1722A IInstrument Controller.	●	
Runs on the properly configured HP Vectra ES12 or IBM PS/2-50 computers.		●
True interrupt handling of GPIB Service Requests (SRQs)	●	●
Accepts user-defined Test Uncertainty Ratios (TUR's), warns when too low		●
Test results report includes system uncertainty		●
Includes system traceability file	●	●
User-configurable header for test results printout	●	●
Automated cal results printout and data recording	●	●
Test results header data and traceability file in Standard Data Format (SDF) for use with spreadsheets and database software	●	●
Easy procedure writing and editing. No cumbersome flow charts or intermediate code required	●	●
Extensive on-line help		●
Supports high-resolution color graphics		●
Compatible with 3rd party text editors		●
Touch sense CRT operator interface	●	
Operator messages can be edited	●	●
Simple system expansion	●	●
Upward compatibility for procedures generated on previous versions of 7411 software	●	●

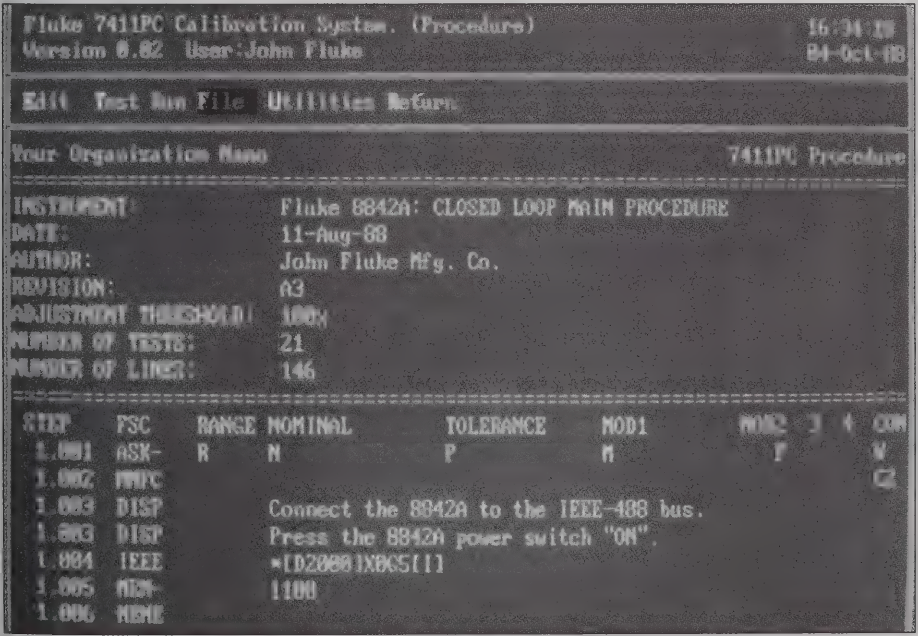
Instrument Driver Function Selection Codes

Instrument	7411PC	7411C
Fluke		
5100B	●	●
5101B	●	●
5200A	● *	● **
5205A	●	●
5215A	●	●
5220A	●	●
5440B	●	●
5450A	●	●
5700A (New)	●	●
6060B	●	●
6061A	●	●
6062A	●	●
8502A	●	●
8505A	●	●
8506A	●	●
8842A (New)	●	●
Tektronix		
CG5001	●	●

** Does not include 5200A accuracy enhancement software*

***Includes 5200A accuracy enhancement software*

Example of 7411PC Procedure Listing



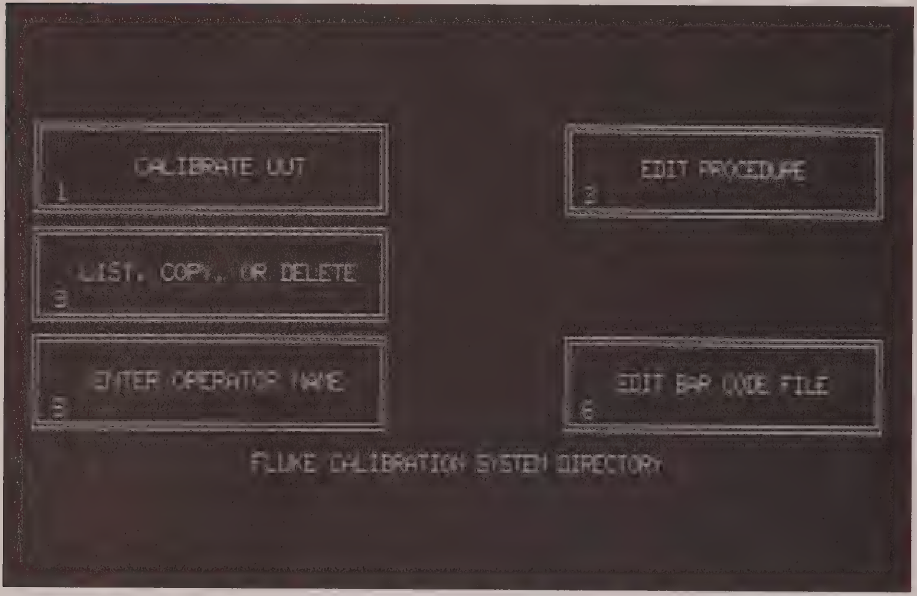
```
Fluke 7411PC Calibration System. (Procedure)                    16:34:19
Version 0.02  User:John Fluke                                   04-Oct-88

Edit  Test Run File  Utilities Return

Your Organization Name                                    7411PC Procedure
==========================================================================
INSTRUMENT:               Fluke 8842A: CLOSED LOOP MAIN PROCEDURE
DATE:                     11-Aug-88
AUTHOR:                   John Fluke Mfg. Co.
REVISION:                 A3
ADJUSTMENT THRESHOLD:     100%
NUMBER OF TESTS:          21
NUMBER OF LINES:          146
==========================================================================
 STEP   FSC   RANGE NOMINAL          TOLERANCE    MOD1         MOD2  3  4 CON
  1.001 ASK-  R     N                P            M               F       W
  1.002 [illegible]                                                       C
  1.003 DISP        Connect the 8842A to the IEEE-488 bus.
  1.003 DISP        Press the 8842A power switch "ON".
  1.004 IEEE        *[D2000]X0CS[I]
  1.005 MEM-        1100
  1.006 MEME
```

7411C

NEW



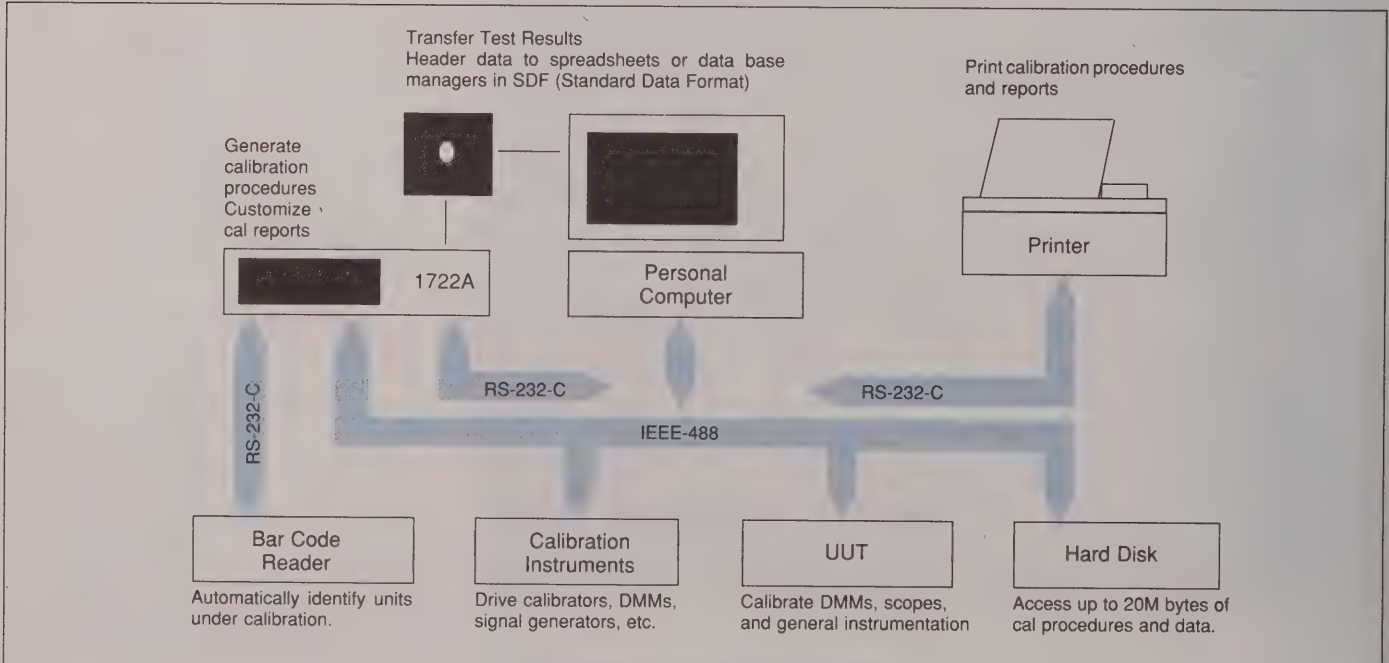
7411C Main Menu with touch-sense selection or numeric selection via keyboard.

Features of 7411C Calibration Software for the Fluke 1722A Touch Screen Instrument Controller.

- Procedures are easy to generate and edit. No programming experience, cumbersome flow charts or intermediate code are required. Example procedures are supplied at no extra charge.
- System operation is easy. Plain language instructions and graphics and the 1722A's touch-sensitive screen and Operators' Aid make entering commands simple and intuitive.
- Test results are automatically recorded.
- Information about the calibration instruments in the system are recorded in a traceability file.
- Cal results data can be off-loaded to a PC or other computer for additional processing and analysis.
- 7411C supports a wide variety of calibration instruments.
- System expansion is simple.
- For existing 7411B users a 5100B to 5700A procedure translation utility is included at no extra charge.

Ordering Information

7411C Calibration Software $2995


Transfer Test Results
Header data to spreadsheets or data base managers in SDF (Standard Data Format)
Print calibration procedures and reports
Generate calibration procedures
Customize cal reports
1722A
Personal Computer
Printer
RS-232-C
RS-232-C
RS-232-C
IEEE-488
Bar Code Reader
Automatically identify units under calibration.
Calibration Instruments
Drive calibrators, DMMs, signal generators, etc.
UUT
Calibrate DMMs, scopes, and general instrumentation
Hard Disk
Access up to 20M bytes of cal procedures and data.

7411C Calibration Software Environment

7411PC

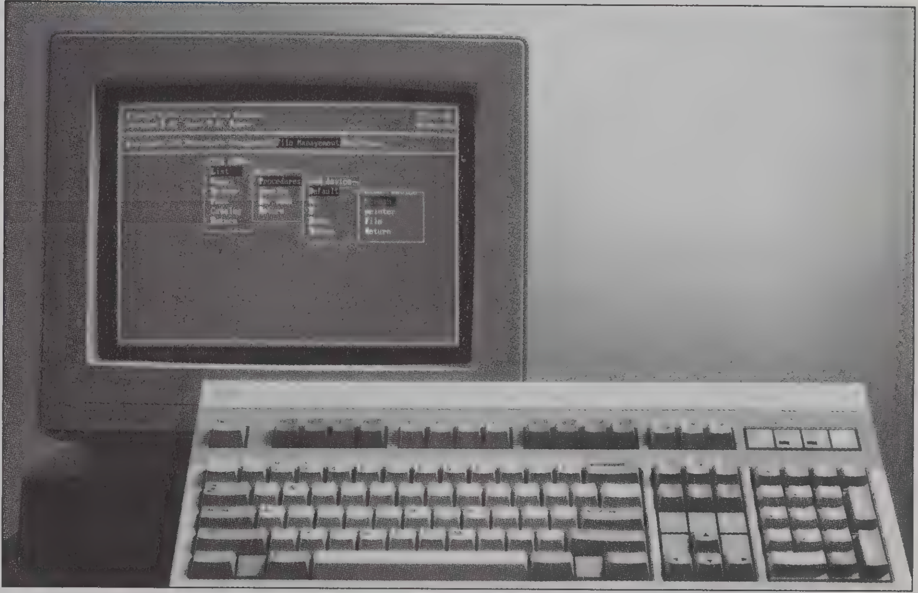
GPIB
IEEE-488

RS-232

NEW

Features of 7411PC Calibration Software for properly configured the HP Vectra ES12 and IBM PS/2 Model 50 computers.

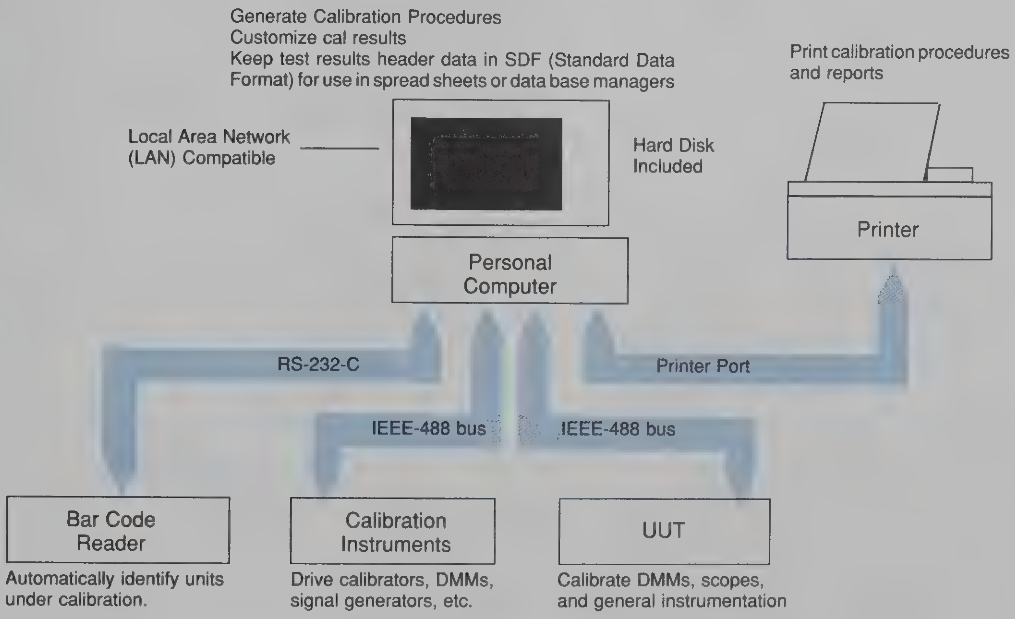
- High resolution color graphics display. Near photo quality illustrations can be included in procedures to prompt the operator.
- All selections are displayed through "pull-down" menus.
- A full screen procedure editor with on-line help is included. Procedures can be generated and run without exiting and reloading parts of the system.
- Commercially available text editors can be substituted for the procedure editor if you desire.
- Comprehensive on-line help screens are included.
- Built-in debugging capability makes it easy to find errors in procedures.
- System accuracy files maintain the operating specifications for each instrument in the system. During procedure generation, when this feature is enabled, the system will alert you if you attempt to verify an instrument with a test uncertainty ratio of less than 4:1.
- All prompts and report formats are stored in ASCII files, so they can easily be edited to fit your application.
- Results report header formats are very flexible, permitting you to include information on a variety of parameters as your documentation requirements dictate.



7411PC Menu Tree with keyboard selection via cursor movement or alpha entry.

Ordering Information

7411PC Calibration Software $4195


Generate Calibration Procedures
Customize cal results
Keep test results header data in SDF (Standard Data Format) for use in spread sheets or data base managers
Print calibration procedures and reports
Local Area Network (LAN) Compatible
Hard Disk Included
Printer
Personal Computer
RS-232-C
Printer Port
IEEE-488 bus
IEEE-488 bus
Bar Code Reader
Calibration Instruments
UUT
Automatically identify units under calibration.
Drive calibrators, DMMs, signal generators, etc.
Calibrate DMMs, scopes, and general instrumentation

7411PC Calibration Software Environment

NEW

Fluke Standard Automated Calibration Systems

Fluke Standard Automated Calibration Systems are designed to offer you a complete solution to the complex task of matching the calibrator, host computer and software, packaging and other accessories with your workload requirements and your budget. As a single vendor, we stand behind your whole system, not just parts of it, from delivery and set-up through training and support.

Fluke offers three standard systems, based on the workload you need to address:

- The 7457A system is based on the Fluke 5700A Calibrator. It addresses the broadest cross section of meters in your workload. Also, because of the 5700A Calibrator's exceptional temperature tolerance, the 7457A system is ideally suited for on-site calibration applications outside the calibration lab.
- The 7451A system is based on the Fluke 5100B Calibrator. It addresses the calibration of medium accuracy multimeters up to 4$^1/_2$ digits, or up to 5$^1/_2$ digits with the 74XXX-8506A accuracy enhancement option.
- The 7409B system is based on the Tektronix CG5001 Oscilloscope Calibrator. It can be configured as a stand-alone system, with its own controller. Or it can be ordered without a controller and operated by the controller in a 7451A or 7457A system.

Each Fluke automated calibration system* comes with one day of start-up assistance. Your system will be delivered by a Fluke application engineer who will unpack it, run functional tests and work with you and your technicians to get it up and running fast.

Depending on your application and the instruments you buy, Fluke Calibration Systems can be packaged in three ways.

For stationary use, instruments may be simply "stacked" together in a bench-top cluster, with no packaging required.

For semi-mobile applications, you can order your Fluke system mounted in a standard 19" wide instrument rack. Rack installation permits a system to be moved about the lab with relative ease while protecting the instruments in it from damage. A single panel provides for single-switch power and brings interface ports forward to the front of the rack. Fluke racks are constructed of heavy-gauge steel. The sides are removable for easy service. All necessary hardware, controller, interface panel, power distribution and ventilation are included, and the rack is delivered from the factory with all instruments installed. If you don't order all the instrument options for a particular rack, all the hardware necessary to install that instrument later is included with the rack.

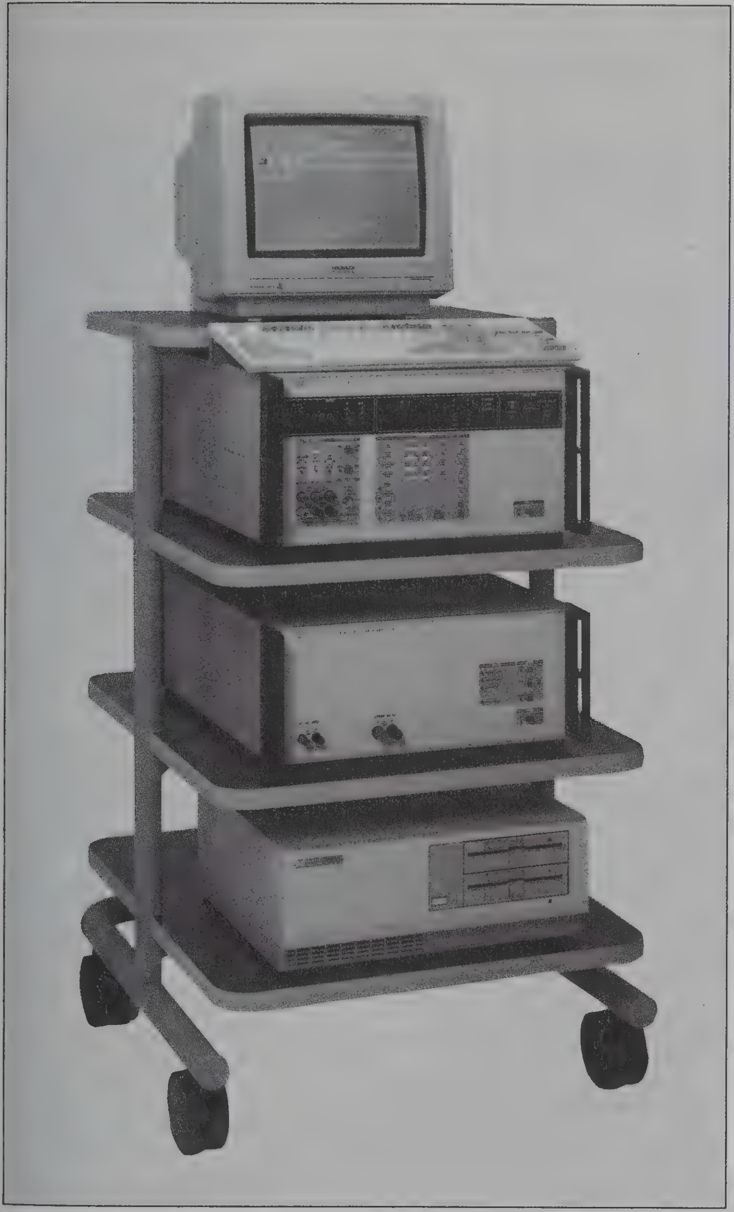
The Lab Cart is a simple, inexpensive alternative to rack-mounting your system. This sturdy, open frame cart has 4" wheels for easy mobility and space for a calibrator, amplifier, controller and monitor.

For mobile applications, any of the rack-mount systems may be ordered with a mobile base that includes semi-pneumatic wheels rather than casters. These wheels isolate the rack from shocks while making it easy to roll the system over such obstacles as expansion joints, cracks, door thresholds, rough surfaces, and so on.

In the following pages you will find a Selection Tree for each of the three standard systems Fluke offers. First, determine the workload you need to cover and the calibrator that meets it. Then simply work your way down the tree, choosing the controller, auxiliary instruments, packaging, lab carts and other accessories that best fit your lab's requirements.

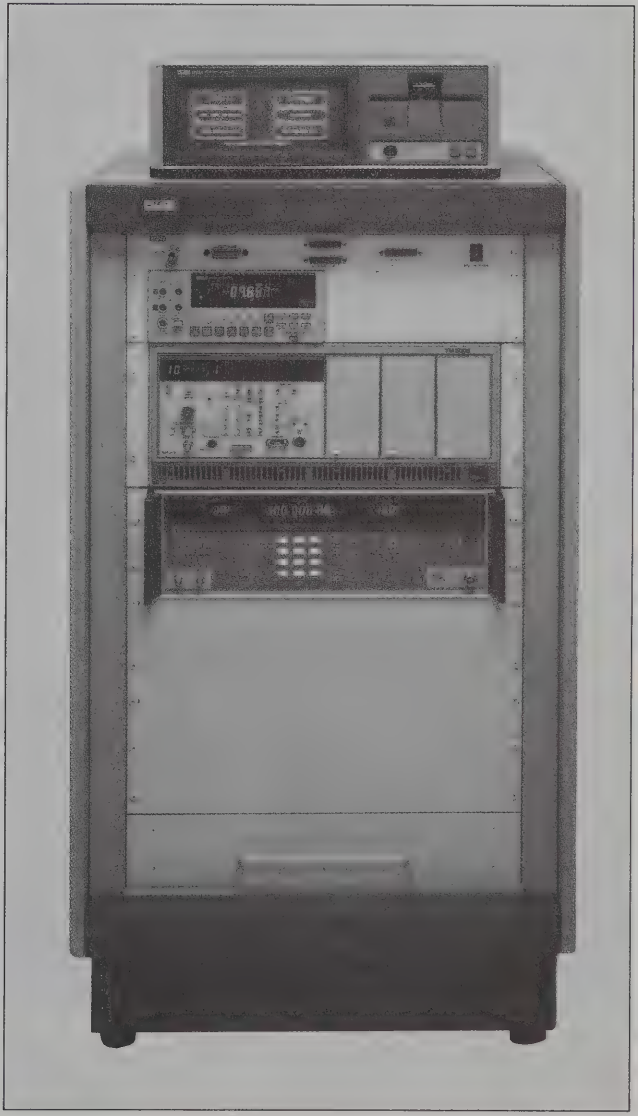
Defined as a Calibrator, Controller, and Software ordered together

7457A PC Controlled Calibration Clusters
PC also available for 7451A and 7409B



7451A Lab-Cart Cluster
Lab-Cart also available for 7457A and 7409B

7409B Rack Mounted System
Rack Mounting and 1722A control also available for 7457A and 7451A

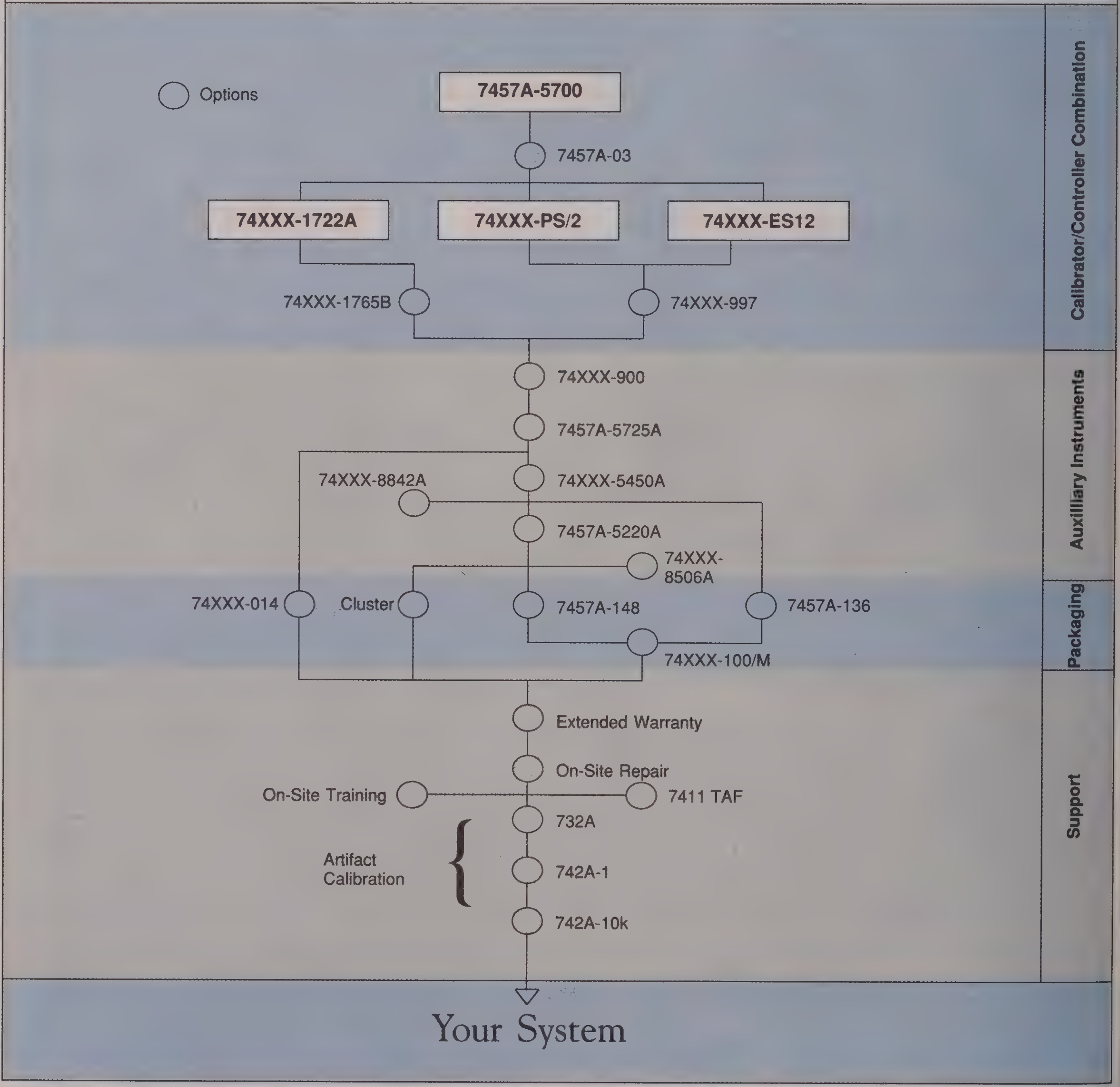


7457A

GPIB IEEE-488

NEW

7457 Automated Calibration System



7457A Automated Meter Calibration Systems

The 7457A is Fluke's highest performance standard system. It is designed to calibrate a wide range of instrumentation in your dc and low frequency ac workload. Due to the 5700A's unique, environmentally tolerant design, 7457A systems are an excellent choice for calibrating high performance instrumentation on site.

Choose your calibrator.

7457A-5700A Calibrator. $20,075
Designed to cover the complete meter cal workload. Sources five functions: Direct voltage to 1100V. Alternating voltage from 200 μV to 1100V with frequencies from 10 Hz to 1 MHz. Resistance from 1Ω to 100 MΩ in x1 and x1.9 values including a short. Alternating and direct current to 2.2A with alternating current output available over frequencies from 10 Hz to 10 kHz. IEEE-488 cable is included. For complete specifications, ask for Fluke document A0296.

Option. 7457A-03 Wideband Voltage. $3,995
Extends the 5700A's frequencyrange to 30 MHz to cover to RF voltmeters.

Choose your system controller.

74XXX-1722A Touch Screen Instrument Controller. $10,875
Includes 7411C Software configured for your system. Easy re-configuration means you can add new instruments at any time. Also included: 1 Mbyte memory expansion. Two IEEE-488/RS-232 interfaces. Operators' Aid. 400 kbyte $5^{1}/_{4}$" floppy disk drive. AC divider. IEEE-488 cable for unit under test (UUT) control.

Option. 74XXX-1765B 20 Mbyte Hard Disk Drive. $3,420
Increases storage capacity and system speed. Eliminates the need to use floppy disks for most operations. Includes IEEE-488 cable for connection to the 1722A.

74XXX-ES12 Controller. $12,616
This selection features the Hewlett-Packard Vectra Model ES12 configured as a system controller. Includes 7411PC Software configured for your system. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 12 MHz 80286 processor. 20 Mbyte hard disk drive. 640 kbyte RAM. Floppy and hard disk controller. Two RS-232 ports. Two parallel ports. One 1.2 Mbyte, $5^{1}/_{4}$" and one 360 kbyte $5^{1}/_{4}$" floppy disk drive. Two IEEE-488 control ports. DOS 3.3. HP EGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

74XXX-PS/2 Controller. $12,861
This selection features the IBM PS/2 Model 50 configured as an instrument controller. Includes 7411PC Software configured for your system. Easy re-configuration means you can add new instruments at any time. The hardware configuration includes: 10 MHz 80286 processor. 20 Mbyte hard disk drive. 1 Mbyte RAM. Floppy and hard disk controller. Three RS-232 ports. One parallel port. Two 1.44 Mbyte, $3^{1}/_{2}$" floppy disk drives. Two IEEE-488 control ports. DOS 3.3. IBM VGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

Choose your auxiliary instruments.

7457A-5725A Amplifier. $7980
Boosts the 5700A Calibrator's current output to 11A for calibration of the higher current ranges of handheld and other meters. It also extends the 5700A's alternating voltage capability to 1100V at 30 kHz and 750V at 100 kHz for calibrating high performance bench and system meters. Includes 5700A interconnect cable. For complete specifications, ask for Fluke document A0296.

74XXX-900 Bar-Code Reader. $1124
This selection adds the capability to read bar-coded property numbers directly. Streamlines identification of the unit to be tested and selection of the proper procedure. Includes an Intermec 9510 bar-code reader, 1260 Series wand with 10' coiled cord, power supply, manual and RS-232 cable.

74XXX-5450A Resistance Calibrator. $4880
Increases the best case resistance calibration accuracy of the system from 11 ppm to 7.5 ppm (±5°C, 90 days). Includes an IEEE-488 cable. For complete specifications, ask for Fluke document A0194.

74XXX-8842A Digital Multimeter. $1560
Adds $5^{1}/_{2}$ digit DMM measurement capability to the system. Cannot be combined with the 74XXX-8506A DMM option described below. Includes a Fluke 8842A/059 with AC and IEEE-488 options, IEEE-488 cable and Y8077 low thermal four-wire short. For complete specifications, ask for Fluke document G0142.

7457A-5220A Transconductance Amplifier. $5930
For calibrating high current ranges of handheld and other meters. Boosts system current capability to 20A. Includes a Y5002 interface cable and 80J-10 10A current shunt. For complete specifications, ask for Fluke document A0075.

74XXX-8506A Digital Multimeter. $4195
Provides for high accuracy $6^{1}/_{2}$digit DMM measurement capability in the system. Can not be combined with the 74XXX-8842A DMM option described above. Includes an 8505A-02A ohms converter and IEEE-488 interface and cable. For complete specifications, ask for Fluke document number G0099.

Choose your packaging.

74XXX-014 Lab Cart. $506
A simple, inexpensive way to move your calibration system from place to place. This sturdy, open frame cart has 4" wheels and space for a calibrator, amplifier, controller, monitor and bar-code reader. Cannot accomodate 74XXX-5450A Resistance Calibrator, 74XXX-8842A DMM, 7457A-5220A Transconductance Amplifier or 74XXX-8506A DMM options due to a lack of room on the cart. Some assembly required.

Cluster. No packaging hardware is required.

7457A-136 36" Instrument Rack and Enclosure. $3985
Provides for complete mechanical integration of the 7457A system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, $3^{1}/_{2}$" storage drawer and rack-mount kits for all 7457A options. Cannot accomodate the 74XXX-8506A DMM or 7457A-5220A Transconductance Amplifier options. See the 7457A-148 48" Instrument Rack and Enclosure described below.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

7457A-148 48" Instrument Rack and Enclosure. $4350
Provides for complete mechanical integration of the 7457A system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, $3^{1}/_{2}$" storage drawer and rack-mount kits for all 7457A options. Rack-mount kit for the 74XXX-8506A DMM is included unless the 74XXX-8842A DMM is selected.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

Choose your support.

Extended Warranty. Extends the factory warranty to two years. Allows you to budget effectively for repair services and shortens turn-around time.

On-Site Repair Service. Convenient. Reduces system down time.

7411TAF Procedure Writing Training. $1250 per person
A five-day course that provides a comprehensive overview of 7411 Calibration Software and its applications in calibration systems. Held regularly at Fluke Service Centers.

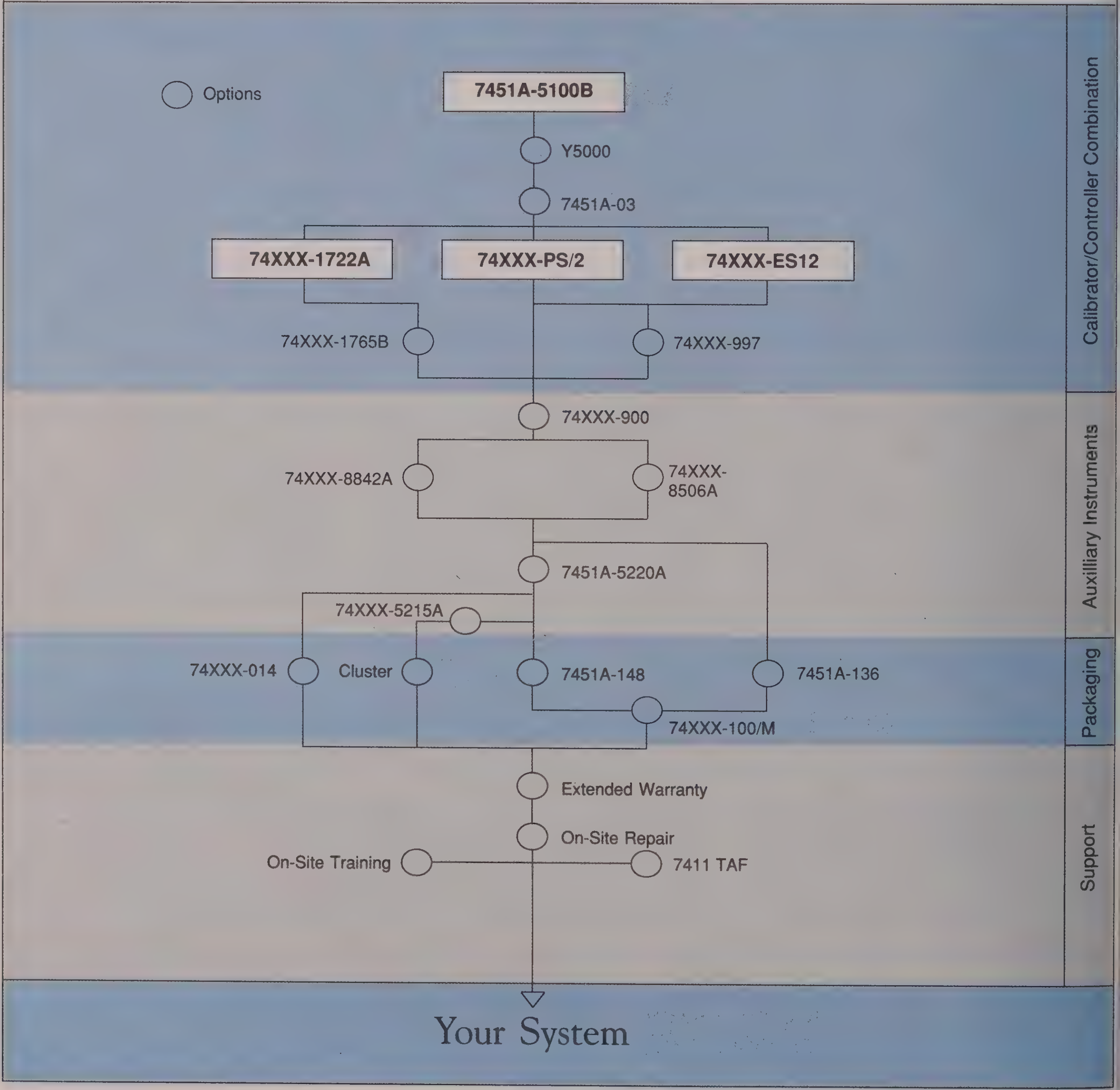
Option. The course can be conducted on-site. Contact your local Fluke Sales office for more information on extended warranty, on-site repair and on-site warranty.

Artifact Calibration. Includes a 732A-100 10V Direct Voltage Reference Standard, 742A-1 Resistance Standard and 742A-10k 10k Resistance Standard to support the Artifact Calibration capability of the 5700A Calibrator. For more information on 5700A Artifact Calibration, ask for Fluke documents A0296 and B0175.

Refer to 732A and 742A sections of this catalog for more information.

7451A

7451 Automated Calibration System



7451A Automated Meter Calibration Systems.

The 7451A system is designed to meet a large cross section of your meter calibration workload — medium accuracy instruments up to 4½ digits. With 8506A accuracy enhancement, it can address the 5½ digit portion of your workload as well. It is based on the Fluke 5100B Calibrator, the most widely used DMM calibrator in the world.

Select your calibrator.

7451A-5100B Calibrator. $12,230
Designed to cover calibration of meters of up to 4½ digits. Sources five functions: Direct voltage to 1100V. Alternating voltage to 1100V with frequencies from 50 Hz to 50 kHz. Resistance from 1Ω to 10 MΩ. Alternating and direct current to 2A. IEEE-488 cable is included. For complete specifications, ask for Fluke document A0295.

Y5000 Interface Buffer. $600
Required if 5215A or 5220A amplifiers are selected.

7451A-03 Wide Band Voltage Option. $3100
Extends the 5100B's frequency range to 10 Hz to 10 MHz to cover RF voltmeters.

Choose your system controller.

74XXX-1722A Touch Screen Instrument Controller. $10,875
Includes 7411C Software configured for your system. Easy re-configuration means you can add new instruments at any time. Also included: 1.0 Mbyte memory expansion. Two IEEE-488/RS-232 interfaces. Operators' aid. 400 kbyte 5¼" floppy disk drive. AC divider. IEEE-488 cable for unit under test (UUT) control.

Option. 74XXX-1765B 20 Mbyte Hard Disk Drive. $3,420
Increases storage capacity and system speed. Eliminates the need to use floppy disks for most operations. Includes IEEE-488 cable for connection to the 1722A.

74XXX-ES12 Controller. $12,616
This selection features the Hewlett-Packard Vectra Model ES12 configured as a system controller. Includes 7411PC Software configured for your system. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 12 MHz 80286 processor. 20 Mbyte hard disk drive. 640 kbyte RAM. Floppy and hard disk controller. Two RS-232 ports. Two parallel ports. One 1.2 Mbyte, 5¼" and one 360 kbyte 5¼" floppy disk drive. Two IEEE-488 control ports. DOS 3.3. HP EGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

74XXX-PS/2 Controller. $12,861
This selection features the IBM PS/2 Model 50 configured as an instrument controller. Includes 7411PC Software configured for your system. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 10 MHz 80286 processor. 20 Mbyte hard disk drive. 1 Mbyte RAM. Floppy and hard disk controller. Three RS-232 ports. One parallel port. Two 1.44 Mbyte, 3½" floppy disk drives. Two IEEE-488 control ports. DOS 3.3. IBM VGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

Choose your auxiliary instruments.

74XXX-900 Bar-Code Reader. $1124
This selection adds the capability to read bar-coded property numbers directly. Streamlines identification of the unit to be tested and selection of the proper procedure. Includes an Intermec 9510 bar code reader, 1260 Series wand with 10' coiled cord, power supply, manual and RS-232 cable.

74XXX-8842A Digital Multimeter. $1560
Adds 5½ digit DMM measurement capability to the system. Cannot be combined with the 74XXX-8506A DMM option described below. Includes a Fluke 8842A/059 with AC and IEEE-488 options, IEEE-488 cable and Y8077 low thermal four-wire short. For complete specifications, ask for Fluke document G0142.

74XXX-8506A Digital Multimeter. $4195
Broadens 5100B Calibrator's workload coverage to 5½ digit DMMs and provides for high accuracy 6½ and 7½ digit DMM measurement capability in the system. Can not be combined with the 74XXX-8842A DMM option described above. Includes an 8505A-02A ohms converter and IEEE-488 interface and cable. For complete specifications, ask for Fluke document number G0099.

7451A-5220A Transconductance Amplifier. $5920
For calibrating high current ranges of handheld and other meters. Boosts system current capability to 20A. Includes a Y5002 interface cable and 80J-10 10A current shunt. For complete specifications, ask for Fluke document A0075.

74XXX-5215A Voltage Amplifier. $10,025
Boosts the 5100B's alternating voltage capability to 1100V at 50 kHz to calibrate instruments that measure these high volt-Hertz levels. Includes Y5001 calibrator interface cable. Can only be selected for cluster systems.

Choose your packaging.

74XXX-014 Lab Cart. $506
A simple, inexpensive way to move your calibration system from place to place. This sturdy, open frame cart has 4" wheels and space for a calibrator, DMM, 5220A amplifier, controller, monitor and bar-code reader. Cannot accomodate the 74XXX-5215A Amplifier option due to a lack of room on the cart. Some assembly required.

Cluster. No packaging hardware is required.

7451A-136 36" Instrument Rack and Enclosure. $3985
Provides for complete mechanical integration of the 7451A system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, 3½" storage drawer and rack-mount kits for all 7451A options. Cannot accomodate the 7451A-5220A Transconductance Amplifier or 74XXX-5215A Amplifier options. See the 7451A-148 48" Instrument Rack and Enclosure described below.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

7451A-148 48" Instrument Rack and Enclosure. $4350
Provides for complete mechanical integration of the 7451A system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, 3½" storage drawer and rack-mount kits for all 7451A options. Rack-mount kit for the 74XXX-8506A DMM is included unless the 74XXX-8842A DMM is selected. 74XXX-5215A Amplifier option cannot be installed in this rack.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

Choose your support.

Extended Warranty. Extends the factory warranty to two years. Allows you to budget effectively for repair services and shortens turn-around time.

On-Site Repair Service. Convenient. Reduces system down time.

7411TAF Procedure Writing Training. $1,250 per person
A five-day course that provides a comprehensive overview of 7411 Calibration Software and its applications in calibration systems. Held regularly at Fluke Service Centers.

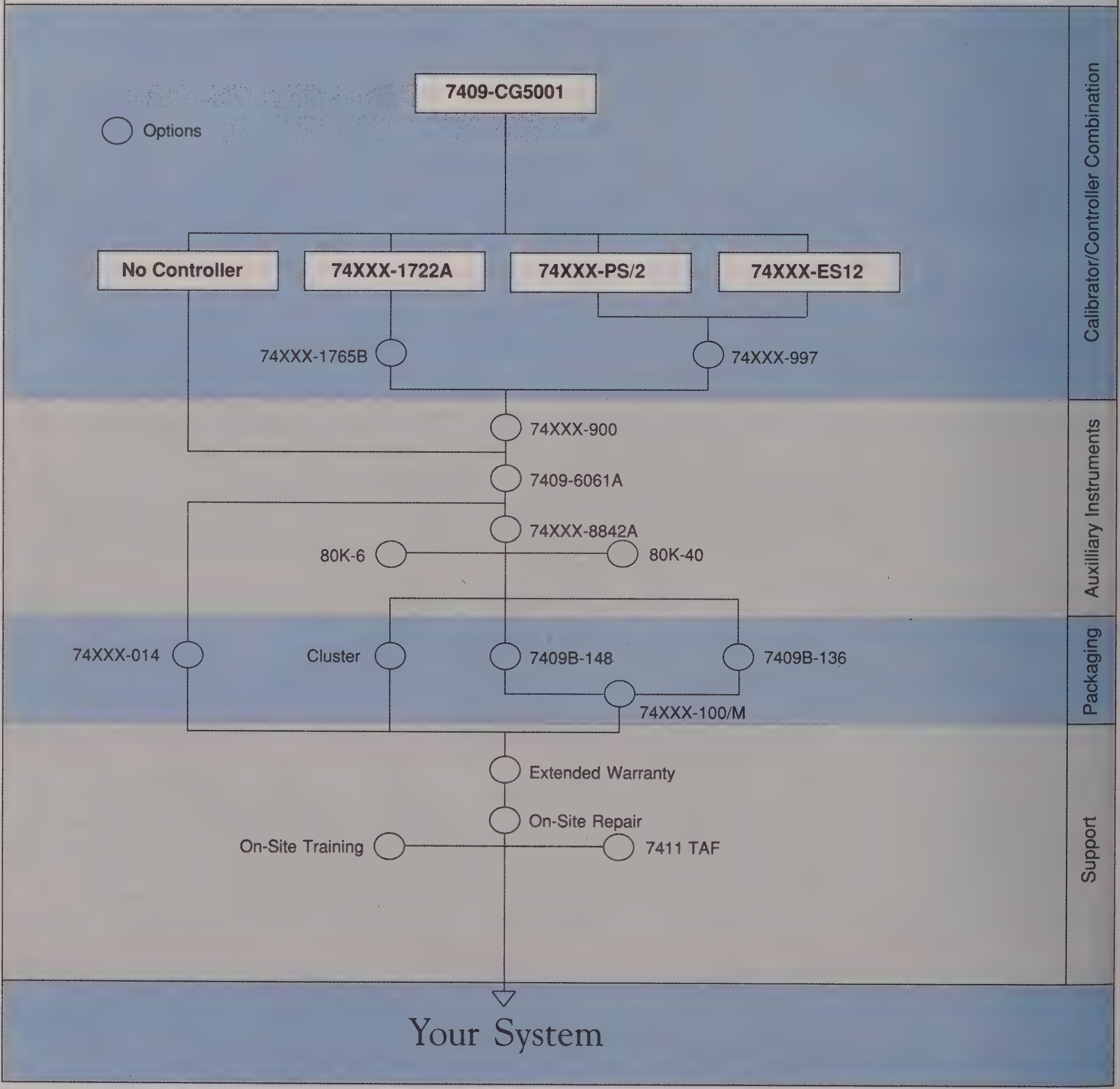
Option. The course can be conducted on-site.

Contact your local Fluke Sales Office for more information on extended warranty, on-site repair and on-site warranty.

7409B

NEW

7409B Oscilloscope Calibration System



7409B Automated Oscilloscope Calibration System.

The 7409B system can be configured with its own controller to operate as a stand-alone analog oscilloscope calibration system. Or it can be ordered without a controller and operated as a supplement to a 7457A or 7451A meter calibration system.

Choose your calibrator.

7409B-CG5001 Oscilloscope Calibrator. $22,081
Verifies vertical gain, horizontal timing and gain, vertical pulse characteristics, probe accuracy and compensation, current probe accuracy and up to six functions for meter calibration.

Choose your controller.

No Controller. The 7409B system is controlled by the controller in a 7457A or 7451A meter calibration system.

74XXX-1722A Touch Screen Instrument Controller. $10,875
Includes 7411C Software configured for your system. Easy reconfiguration means you can add new instruments at any time. Also included: 1.0 Mbyte memory expansion. Two IEEE-488/RS-232 interfaces. Operators' Aid. 400 kbyte 5$^1/_4$" floppy disk drive. AC divider. IEEE-488 cable for unit under test (UUT) control.

Option. 74XXX-1765B 20 Mbyte Hard Disk Drive. $3420
Increases storage capacity and system speed. Eliminates the need to use floppy disks for most operations. Includes IEEE-488 cable for connection to the 1722A.

74XXX-ES12 Controller. $12,616
This selection features the Hewlett-Packard Vectra Model ES12 configured as a system controller. Includes 7411PC Software configured for your system. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 12 MHz 80286 processor. 20 Mbyte hard disk drive. 640 kbyte RAM. Floppy and hard disk controller. Two RS-232 ports. Two parallel ports. One 1.2 Mbyte, 5$^1/_4$" and one 360 kbyte 5$^1/_4$" floppy disk drive. Two IEEE-488 control ports. DOS 3.3. HP EGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

74XXX-PS/2 Controller. $12,861
This selection features the IBM PS/2 Model 50 configured as an instrument controller. Includes 7411PC Software configured for your system. Easy re-configuration means you can add new instruments at any time. The hardware configuration includes: 10 MHz 80286 processor. 20 Mbyte hard disk drive. 1 Mbyte RAM. Floppy and hard disk controller. Three RS-232 ports. One parallel port. Two 1.44 Mbyte, 3$^1/_2$" floppy disk drives. Two IEEE-488 control ports. DOS 3.3. IBM VGA color monitor. AC divider. IEEE-488 cable for UUT control.

Option. 74XXX-997 Operators Aid. $779
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

Choose your auxiliary instruments.

74XXX-900 Bar-Code Reader. $1124
This selection adds the capability to read bar-coded property numbers directly. Streamlines identification of the unit to be tested and selection of the proper procedure. Includes an Intermec 9510 bar code reader, 1260 Series wand with 10' coiled cord, power supply, manual and RS-232 cable.

7409B-6061A Synthesized RF Signal Generator. $6025
Provides an accurate amplitude signal from 10 kHz to 1.05 GHz for verifying oscilloscope bandwidth. Includes IEEE-488 cable.

74XXX-8842A Digital Multimeter. $1560
Adds 5$^1/_2$ digit DMM measurement capability to the system. Includes a Fluke 8842A/059 with AC and IEEE-488 options, IEEE-488 cable and Y8077 low thermal four-wire short. For complete specifications, ask for Fluke document G0142. 80K-6 High Voltage Probe. Extends the 8842A's voltage measurement capacity to 6000V. 80K-40 High Voltage Probe. Extends the 8842A's voltage measurement capacity to 40000V.

Choose your packaging.

74XXX-014 Lab Cart. $506
A simple, inexpensive way to move your calibration system from place to place. This sturdy, open frame cart has 4" wheels and space for a calibrator, signal generator controller, monitor and bar-code reader. Cannot accomodate the 74XXX-8842A DMM option due to a lack of room on the cart. Some assembly required.

Cluster. No packaging hardware is required.

7409B-136 36" Instrument Rack and Enclosure. $3985
Provides for complete mechanical integration of the 7409B system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, 3$^1/_2$" storage drawer and rack-mount kits for all 7409B options.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

7409B-148 48" Instrument Rack and Enclosure. $4350
Provides for complete mechanical integration of the 7409B system into one enclosure. Designed primarily for stationary use. Includes a caster base for movement on hard, level surfaces. Also included: power/controller interface panel, line power distribution contactor, fan, 3$^1/_2$" storage drawer and rack-mount kits for all 7409B options.

Option. 74XXX-100/M Mobile Base. $150
Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

Choose your support.

Extended Warranty. Extends the factory warranty to two years. Allows you to budget effectively for repair services and shortens turn-around time.

On-Site Repair Service. Convenient. Reduces system down time.

7411ATF Procedure Writing Training. $1,250 per person
A five-day course that provides a comprehensive overview of 7411 calibration software and its applications in calibration systems. Held regularly at Fluke Service Centers.

Option. The course can be conducted on-site.

Contact your local Fluke Sales office for more information on extended warranty, on-site repair and on-site warranty.

A123

GPIB IEEE-488

RS-232

Fluke Custom-Designed Automated Calibration Systems.

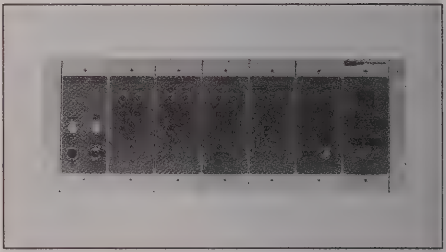
Flexibility is the key word for Fluke's custom automated calibration workstations. Now you can select the instrument combinations necessary to automate your calibration needs. Fluke offers a wide selection of both meter and oscilloscope calibration instruments which can be configured to satisfy your requirements and your budget. these workstations combine the accuracy of computer-aided calibration, the convenience of a test interface panel and the flexibility of customized configurations to meet a wide range of applciations. These workstations can be mounted in mobile racks to allow the calibrator to be easily transported to the work site.

Fluke will configure arrangements of various instruments. Contact your local Fluke Sales Representative for help in configuring a workstation.

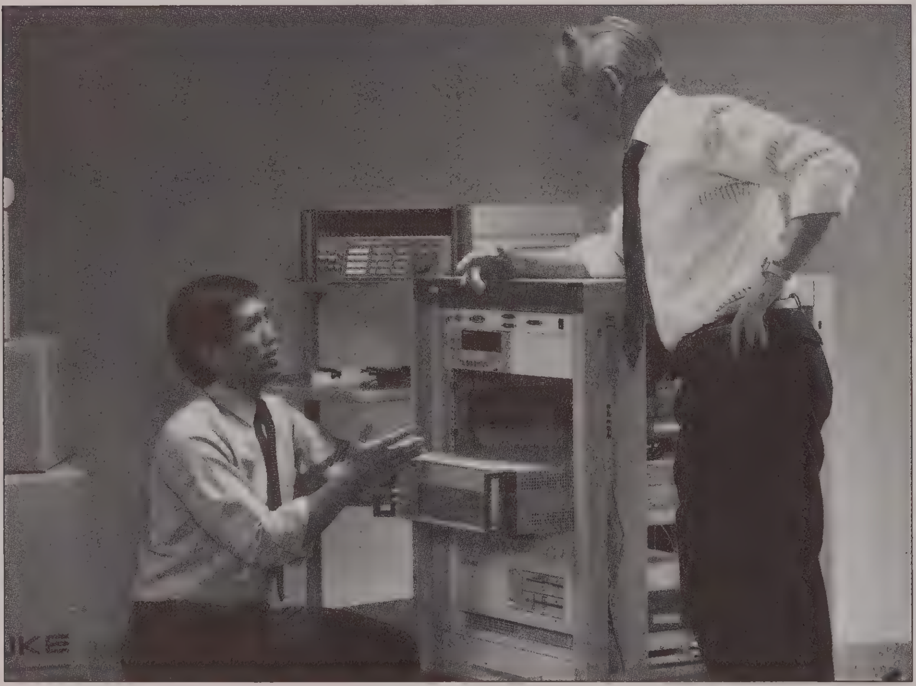
The Fluke A123 - Automated Meter Calibration Workstation

The Fluke A123 is a computer-aided automated calibration workstation which can be configured in a variety of ways to calibrate even the most accurate DMMs and oscilloscopes. All systems provide complete sourcing capabilities of direct volts, alternating volts, direct current, alternating current and resistance as well as measuring capability for direct volts, alternating volts, and resistance. Optional equipment can be added to extend the frequency range and also boost the alternating voltage output and current output.

The unit under test (UUT) is connected to the A123 through the Modular Test Interface Panel (MTIP). This provides all the connectors for the system instruments as well as the controller's data ports. The UUT can be connected to the 1722A's port for closed-loop calibration via the IEEE-488 bus. In this case, the operator simply starts the calibration test and the system digitally calibrates itself and the UUT.



Modular Test Interface Panel



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Specifications subject to change without notice. Some products and services may not be available outside the U.S. Contact your local Fluke or Philips representative for details.

Standards for Your Traceability Requirements

The best of instruments are only useful when you can depend on them to make accurate measurements. Fluke supports the accuracy of the instruments it sells through a line of calibration instruments and standards. Because these instruments have excellent short- and long-term stability, they are the ideal choice for transferring and maintaining electrical traceable units in your facility.

Two of the most recent additions to Fluke's line of standards are the 732A Direct Voltage Reference Standard and the 752A Reference Divider, developed to support the accuracy requirements of the 5440 Series Calibrators and Fluke's own Primary Standards Lab. These two standards make it possible for you to maintain direct voltage standards in your facility with accuracies not previously attainable outside a national laboratory. Also, an innovative calibration scheme, the Direct Voltage Maintenance Program, is operated by Fluke to make it possible for you to maintain this superb accuracy.

As Fluke continues to advance the state of the art in measurement and calibration, there will be a continuing need for better, more accurate, and more effective ways to assure your measurements are accurate. You can have complete confidence in Fluke's commitment to supporting existing and future instruments through effective standards and innovative, efficient methods for applying them to your needs.

aV Standards and Accessories

- 540B Thermal Transfer Standard
- 510A AC Reference Standard
- A40 and A40A Current Shunts
- A55 Thermal Converters

Resistance Standards

- 742A Resistor Standards

dV Standards and Accessories

- 732A dV Reference Standard
- Transport Case and Battery Charger for 732A
- Direct Voltage Maintenance Program
- 731B dV Reference Standard

Dividers, Lead Compensators, and Null Detectors

- 752A Reference Divider
- 750A Reference Divider
- 720A Kelvin-Varley Divider
- 721A Lead Compensator
- 845AB/AR Voltmeter/Null Detector

"Principles of Metrology" Course

The Fluke Principles of Metrology training course provides five days of intensive training for solving the problems of day to day cal lab operation. The course includes practical tips and exercises to illustrate:

- Loading errors
- Lead impedance
- Using voltage dividers
- Low level measurements
- Thermal EMFs
- Grounding and guarding

The course also includes in-depth discussions of traceability and measurement uncertainty, and general background information on the role of calibration and metrology. The course is designed to make your technicians more productive in calibrating test instrumentation. The student will begin to see and use creative techniques for specific measurement and calibration applications.

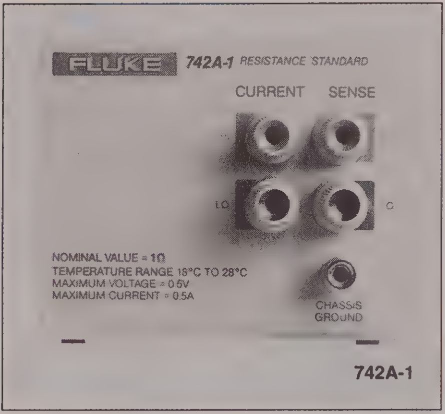
Traceability

Traceability means that there is a documentable link between the accuracy of an instrument and the highest level of standards as maintained by a national or international laboratory. The highest level of standards are referred to as legal standards. This means that they are recognized among several nations as being the standard of reference. The standards themselves may take the form of physical constants or natural phenomena, standard reference material, or proven ratio techniques.

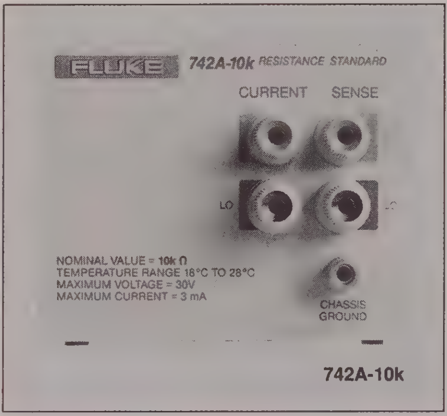
Traceability requirements must be fulfilled in order for you to have confidence in your measuring instruments. Traceability requirements are often legal as well as practical requirements. You can think of traceability as the pedigree of measurement much like tracing the bloodline of champion animals. From a particular calibration job, each measurement can be traced all the way back to national standards. This trail of calibration is carefully recorded along with the details of the procedure. This typically includes the conditions of the test, the instruments used to make the calibration, and the time between calibrations.

742A

NEW



742A-1



742A-10k

742A Resistance Standards

- Small and rugged
- No oil or air baths required
- 18°C to 28°C operating range
- Supplied with temperature characterization
- Six month stability to 2.5 ppm

Fluke 742A Standard Resistors are high accuracy working standards for precision, on-site resistance calibration. Their excellent temperature stability allows them to be used from 18°C to 28°C with typically less than 2 ppm degradation. Using the calibration table supplied with the standards, which lists corrections in 0.5°C increments, this uncertainty can be reduced to near zero. No cumbersome oil or air baths are required.

Because 742A Standard Resistors are small and rugged, they are easy to transport. Care has been taken to reduce resistance changes brought about by thermal and mechanical shock. Retrace (permanent shift in resistance) is typically less than 2 ppm after cycling between 0°C and 40°C.

A convenient transit case, designed to hold two standards, is available as an option.

Optional 742A-7002 transit case.

Specifications

Nominal Value:
742A-1: 1Ω ±2 ppm;
742A-10k: 10 kΩ ±2 ppm
Calibration Uncertainty at 23°C: ±1 ppm
Operating Temperature: 18°C - 28°C
Stability (6 months):
742A-1: 5 ppm; 742A-10k: 2.5 ppm
Stability (12 months):
742A-1: 8 ppm; 742A-10k: 4 ppm
Maximum Voltage:
742A-1: 0.5V; 742A-10k: 30V
Storage Temperature: 0°C - 40°C
Retrace (permanent change in R):
18°C to 28°C cycle: Negligible
0°C to 40°C cycle: <2 ppm
Report of Calibration: Table of resistor values for 18°C to 28°C in 0.5°C increments.
Size: 3.4 in H x 4.15 in W x 5 in D
Weight:
742A-1: 2 lbs.
742A-10k: 1.7 lbs.

Ordering Information

Models

January 1989 prices

742A-1 1Ω Resistance Standard	$795
742A-10k 10 kΩ Resistance Standard ..	695
742A-7002 742A Transit Case; holds two unit	195

(NSN 6625-01-175-1193) **732A**

732A dV Reference Standard

- 10V, 1V and 1.018V outputs
- 0.5 ppm stability per month
- 18°C to 28°C operation at full accuracy specs
- Short circuit proof
- Traceable calibration to NBS Fluke Direct Volts Maintenance Program
- Line and rechargeable battery powered
- 12-hour battery life for calibration transfer

The Fluke 732A is a solid state, dV reference standard which provides significant performance improvements in stability, ruggedness, and transportability. Its 10V output offers better resolution, lower noise, and simpler operation than standard cells. The 732A also includes outputs of 1.0 and 1.018 volts.

The accuracy and stability of the 732A allows direct substitution for saturated standard cells in many aplications. Its stability of 0.5 ppm for 30 days provides the confidence necessary to calibrate high-performance instruments. In addition, the use of the 10V output as a primary reference standard means that the effects of thermal emfs and noise are reduced.

The 732A can be shorted, even for extended periods of time, without damage and recovers without loss of stability. The unit may be powered by line voltage or will operate 12 hours on its internal battery — even longer on external batteries. Either line power or the external battery may be removed without affecting the output.

Saturated standard cells are fragile and susceptible to shock and vibration during traveling. The 732A was designed for air or ground shipment with no special handling.

The internal oven has high thermal gain allowing full accuracy to be specified over an operating range of 23°C ±5°C. Therefore, this new reference standard may be used outside of the conventional standards laboratory environment in areas where saturated cells or other transfer standards would not be accurate.

The 732A dV Reference Standard was originally developed by Fluke to transfer the volt into our own manufacturing facility. The unprecedented success achieved by this effort led to the development of the 732A for the commercial market. Fluke has developed a worldwide network of regional support centers to provide calibration support for the 732A where local standards are not available. These centers maintain volt-transfer programs with the national standards laboratories.

Transport Case and Battery Charger

The 732A-7002 Transport Case is a rugged, fiberglass, foam-lined case capable of holding a 732A dV Reference Standard and a 732A-7003 Battery Charger, complete with up to four 732A-7005 Battery Packs. The extra battery capacity of four Battery Packs plus the heat-conserving insulation of the foam lined case will extend the off-line operating time of the 732A to about 72 hours.

The 732A-7003 Battery Charger is specially designed to hold and charge from one to four Battery Packs with the proper constant current, constant voltage cycle to avoid damage from over-charging. Fully discharged batteries are returned to approximately 95% charge in 24 hours. The charger provides the necessary isolation diodes and interconnections to provide the optimum charge to battery packs which may have unequal capacities or states of charge and to connect the batteries to the 732A dc power input connector.

Specifications

Technical Specifications

Absolute Uncertainty: The 732A is normally delivered without absolute uncertainty specifications because, to maintain calibration as a traceable standard, the 732A must continue to receive uninterrupted operating voltage from line power or from the self-contained batteries, which provide approximately 12 hours of off- line operation. The 732A is normally shipped from the factory with the battery switch turned off. Upon receipt, the 732A must be powered up and stabilized for 24 hours before calibration against traceable standards. The absolute un certainty specifications for the 732A must then relate to the uncertainty specifications of the traceable standards used for this calibration.

For a certified calibration by the Fluke Standards Laboratory and shipment under power, refer to the 732A-000 and 732A-100 options described under the Direct Voltage Maintenance Program, next page.

These specifications include effects of line voltage variations of ±10% and assume the 732A has been continuously powered.

Stability: Parts per million, 18°C to 28°C

Output	30 Days	90 Days	6 Months	1 Year
10V	±0.5	±1.0	±1.5	±3.0
1.018V	±1.5	±4.0	±6.0	±12.0
1V	±1.5	±4.0	±6.0	±12.0

Temperature Coefficient: ±0.05 ppm per °C for 10V range, ±1.0 ppm per °C for 1V and 1.018V ranges, from 18°C to 0°C to or 28°C to 40°C

Output Adjustment: ±50 µV for 10V and 1.018V ranges, ±5 µV for 1.0V range

Output Impedance: 1 mΩ for 10V output, 1 kΩ for 1V and 1.018V outputs

Output Current: ≤12 mA at 10V output. Limited by 1 kΩ output impedance at 1V and 1.018V output

Output Protection: May be shorted indefinitely. Protected against high voltage input transients to 1100V

Load Regulation: ≤1.2 ppm at 10V output from 0 to 12 mA

Line Regulation: ≤0.05 ppm of output for ±10% line change

Output Noise: ≤1 µV rms at 10V output from 0.1 Hz to 10 Hz

**Note: See the Direct Voltage Maintenance Program description on page 231 for the improved specifications and traceability which can be obtained for the 732A.*

General Specifications (732A)

Temperature: 0°C to 40°C, operating; 0°C to 50°C, non-operating (with internal battery pack switched off

Relative Humidity: ≤95% to 30°C, ≤75% to 40°C, non-condensing

Altitude: ≤3050m (10,000 ft) operating

Vibration: Per MIL-T-28800, Type III, Class 5, Style E

Safety: IEC 348, 2nd edition, 1978 and ANSI C39.5, 1980

Power: 100V, 120V, 220V, or 240V ac ±10%, 50 to 400 Hz or 24 to 30V ac 50 to 60 Hz. Also external 24 to 40V dc. Internal 24-V lead acid, gelled electrolyte battery operates for 12 hours at 23°C when fully charged. Trickle-charged continually when external power is applied

Size: 19.1 cm H x 22.1 cm W x 60.3 cm D (7.53 in x 8.69 in x 23.75 in)

Weight: 12.3 kg (27 lb)

Included: Instruction manual, line cord, adjustment tool and one 732A-7003 Battery Pack

732A-7002 Transport Case

Size: 77 cm x 61 cm x 31 cm (30 in x 24 in x 12 in)

Weight: 12 kg (26 lb)

732A-7003 Battery Charger

Input Power: 100V, 110V, 115V, 120V, 200V, 220V, 230V, or 240V ac 10%, 50 to 400 Hz, 100W max

Size: 61 cm x 19 cm x 22 cm (24 in x 8 in x 9 in)

Weight: 5.9 kg (13 lb) alone; 23 kg (50 lb) when equipped with four battery packs (732A-7005)

Ordering Information

Models

January 1989 prices

732A DC Reference Standard	$3800
732A-000* w/Special Calibration, shipped hot**	4040
732A-100* w/Special Calibration and Drift Certification, shipped hot**	4245

* *See page 231 for description*

** *Under power*

Accessories (Also see page 485)

732A-7002 Transit Case	625
732A-7003 Battery Charger and Auxiliary Battery Case	1465
732A-7004 Rack Shelf (Holds 2 732As or 732A and 752A)	340
732A-7005 Replacement Battery Pack	375
5440A-7002 Low Thermal Copper EMF Plug-in Cables	350
845AB Voltmeter/Null Detector w/battery	2490
845AR Voltmeter/Null Detector w/rack mount	2350

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-732A Repair (w/calibration)	210
SC2-732A Cal	182

Direct Voltage Maintenance Program

- Volt traceability for your calibration laboratory with significant cost reductions over direct NBS calibration
- Uncertainty within a few tenths of a ppm
- Complies with MIL-STD-45662
- Avoid investing in redundant hardware: equipment never needs to leave laboratory
- No possibility of accidental loading and destruction as with saturated standard cells

Built around the 732A Direct Voltage Reference Standard, the Fluke Direct Voltage Maintenance Program (DVMP) provides state-of-the-art uncertainty for your own laboratory, traceable to the U.S. National Bureau of Standards (NBS). The 732A is a solid-state direct voltage reference standard which enables voltage transfers with uncertainties of only a few tenths of a ppm, while meeting the requirements for ruggedness and a range of operating temperatures. This level of performance is made possible by the low, predictable drift rate, allowing accurate extrapolation of the output voltage to be made over long time intervals. With the DVMP, dissemination of the legal volt can be easily accomplished with an uncertainty of less than one ppm.

Traceability

Traceability to the legal volt is the principle objective of the DVMP. The Fluke Primary Standards Laboratory in Everett, Washington (U.S.A.) maintains traceability to NBS and other national standards laboratories at the 10 volt level. Fluke establishes a "Traceability Plane" for you consisting of the mean (average) of the reference voltages maintained by your participating laboratories.

Four Services, Six Options to Choose From

The Fluke Direct Voltage Maintenance Program consists of four calibration services, resulting in six possible options, which can be used separately or in combination, depending on your needs. Two of the services are calibrations, performed completely by Fluke personnel, in the Fluke Standards Lab. These calibrations may be ordered as an option on a new 732A or as an option to be added to a 732A purchased previously. The other two calibration services are performed by the user, using a Fluke-owned standard, at the user's site, with the data transmitted to the Fluke Standards Lab for reduction and analysis. Complete description of the options follows:

1. **Option 732A-000.** Order this option to have an output voltage calibration performed on a newly ordered 732A. Before shipment, your new 732A will be compared to the direct voltage standards maintained in the Fluke Primary Standards Laboratory which are regularly compared to the Legal Voltage Standards maintained by the U.S. National Bureau of Standards. A report of calibration, listing the deviation from the nominal and the uncertainty of calibration is delivered with the instrument. The instrument will be delivered under power from self-contained and auxiliary batteries to insure the calibration.
2. **Option 732A-000R.** This is the option to order for calibration or re-calibration of a 732A purchased previously. Your 732A, when returned to the factory, will receive the same calibration as detailed under 732A-000 above, and will be returned to you under power.
3. **Option 732A-100.** Order this option to have a new instrument calibration for output voltage and characterized for drift rate before shipment from the factory. Your new 732A will be tested for both output voltage and drift rate by comparison against traceable standards for a period of 60 days in the Fluke Primary Standards Laboratory. Knowing the drift rate, the total uncertainty as a function of time is much reduced. A report of calibration, listing output voltage, drift rate, and uncertainties is delivered with the instrument which is delivered under power.
4. **Option 732A-100R.** This is the option to order for output voltage calibration and drift rate testing of a 732A purchased previously. Your 732A, when returned to the factory, will receive the same calibration and 60 day drift rate characterization as detailed under 732A-100 above, and will be returned to you under power.
5. **Option 732A-200.** This is the option to order for calibration of your 732A in your own laboratory. A Fluke-owned, calibrated 732A, together with all necessary connecting cables and clear operating instructions, will be sent to your site for comparison with your reference standard. A series of readings you make over a period of five days is recorded and returned to Fluke for evaluation at the Fluke Primary Standards Laboratory. A value is then assigned to your 10 volt standard, relative to the legal volt, and a report of calibration is returned to you. The quoted price for the 732A-200 option includes the shipping costs for the Fluke-owned 732A.
6. **Option 732A-201.** If you have more than one 732A in your lab, this is the option to order for calibration of each additional reference at the same site (must be ordered with Option 732A-200). Data collected by the user will be reduced and evaluated by the Fluke Standards Lab, and a report of calibration issued for the reference standard.

Specifications

Option Number	Calibration Uncertainty (CU)*	Drift Rate Uncertainty (DU)**			Total Uncertainty
		30 Days	90 Days	1 Year	
732A-000	0.6 ppm	0.5 ppm	1.0 ppm	3.0 ppm	$\sqrt{[(CU)^{2+} + (DU)^2]}$
732A-100	0.6 ppm	0.35 ppm	0.5 ppm	1.5 ppm	
732A-200	0.6 ppm	**	**	**	

* *Typical 99% confidence level; actual uncertainties determined at the time of test*

** *Drift rate uncertainty will be established with repeated participation in the DVMP*

How To Order

Note: At the present time, due to the difficulty in making timed shipment to international customers, calibration services requiring under power shipment are only available in selected countries.

It is important to recognize that proper timing and coordination of the activities between Fluke and your firm are essential to successful delivery of a 732A under power. Following receipt of an order for one of the DVMP services, you will be contacted directly by Fluke factory personnel. For this reason the following information must be included with each order:

- The option number ordered.
- If options 732A-000R or 732A-100R are ordered, include the serial number of the instrument to be returned to Fluke for the service.
- The exact address where the shipment will be received.
- The name and telephone number of the person who will be responsible for receiving the shipment and connecting it to the power line when it arrives.
- The name and telephone number of an alternate responsible person if the first designated individual is unavailable.
- Any restrictions on hours of the day during which receiving can take place.
- Fluke guarantees arrival of the instrument under power. If it is delayed, Fluke or the carrier will pay the shipping charges for return of the instrument to Fluke for recalibration.

Direct Voltage Maintenance

Ordering Information

Models	January 1989 prices
732A-000 New 732A w/Special Cal, shipped under power	$4040
732A-000R Special Calibration, shipped under power	295
732A-100 New 732A w/Cal, shipped under power	4245
732A-100R Calibration, Drift Certification, shipped under power	550
732A-200 On-Site 10V Certification w/Fluke Standard (includes shipping charges)	495
732A-201 Certification of Additional Reference/Same Site	125

Test Uncertainty Ratio

If you talk with metrologists long enough, inevitably you will hear a spirited discussion about just how accurate calibration equipment needs to be. A common measure of th relationship between the accuracy of the tester and the unit-under-test uncertainty ratio (TUR). (You also may have heard the term test accuracy ratio, but undertainty is the correct term for the small deviations from ideal behavior being described.) Simply defined:

$$\text{TUR}= \frac{\text{Uncertainty of Unit Under Calibration}}{\text{Uncertainty of the Calibrator}}$$

For many low-accuracy instruments, a common rule of thumb is a TUR of 10 or higher. For higher accuracy instruments, standards may not be available that are 10 times more accurate, so a figure of TUR = 4 frequently is used. Finally, when computing the buildup of errors in a traceable chain of standards from the national standards lab (such as the NBS), TURs typically are not used at all.

What is happening? To understand, it is useful to consider the statistical nature of the inaccuracy of an instrument. Consider the undertainty of a voltmeter's measurement of 10V dc. A curve can be used to describe the probability of a given uncertainty. A typical modern DMM with numerous, independent sources of error might have the "bell-shaped" normal distribution. The manufacturer's spec is an educated prediction which most instruments will meet under a given set of time, temperature and other environmental conditions. Fluke's goal, for a typical multimeter, is that 99.7 percent of the errors will fall within spec (±3 standard deviations).

For traceable calibration, we must add the uncertainty of the calibration source to the relative DMM uncertainty to calculate absolute uncertainty. The figure shows the probable errors of the calibration. After calibration, the DMM error curve will be slightly broader as a result of calibrator error. The errors of the two instruments may be added directly, however, because of their statistical and independent nature. they add in root-sum-squares (rss) fashion:

$$E_{total} = \sqrt{(E_{dmm})^2 + (E_{cal})^2}$$

If the DMM error spec is 10 ppm and the calibrator error spec is 2.5 ppm, the total error spec after calibration will be 10.31 ppm. If the calibrator was as accurate as 1 ppm, th resultant DMM spec would be 10.05 ppm. In other words, if we are using a spec of 10 ppm for the DMM, after calibration the chance of being within spec only drops from 99.7 percent to 99.64 percent for 2.5 ppm calibration. The change is about .01 percent for the 1 ppm calibration.

And when should TURs never be used? Normally, when basic standard values, such as the volt, are transferred from the NBS down through the chain of standards labs, most metrologists track each separate source of error and add it to the previous total. The additions would be statistical for uncorrelated errors, so rss sums are used frequently. More conservative metrologists use only linear addition of error terms, which results in larger error factors and a better chance of being correct. It all depends on what needs are being satisfied, which is probably why, if you talk with a group of metrologists long enough, you will hear a spirited discussion.

752A

(NSN 6625-01-175-1192) **752A**

752A Reference Divider

- 10:1 and 100:1 division ratios
- Ratio accuracy of 0.2 ppm on 10:1 ratio
- Ratio accuracy of 0.5 ppm on 100:1 ratio
- Built in calibration bridge

The Fluke 752A Reference Divider sets new standards for direct voltage ratio accuracy and ease of use. It offers two divider outputs, 10:1 and 100:1 with output uncertainties of less than 0.2 ppm and 0.5 ppm respectively.

Before each use, the 752A is easily calibrated with only a stable voltage source and null detector like the Fluke 845AB or 845AR. The entire procedure requires only five minutes and does not require external standards.

The 752A also includes internal switching for calibrating the 100 mV, 1V, 10V, 100V, and 1000V ranges of a voltage calibrator to a 10V reference source (such as the Fluke 732A dV Reference Standard) without having to change the lead connections. It provides the voltage division capability required to calibrate state-of-the-art calibrators and similar instruments.

A "self-calibration" procedure allows you to compensate for long term changes in value of the divider resistors by switching their positions in various Wheatstone bridge configurations and using the BALANCE pot on the front panel.

Specifications

These specifications apply for the lifetime of the instrument over the temperature range of 18°C to 28°C.

Ratio Ranges: 10:1 and 100:1

Ratio Accuracy: The following table specifies the ratio accuracies of the 752A that apply for a temperature variation of less than ±1°C from the self-calibration temperature (between 18°C and 28°C) for up to 8 hours following self-calibration.

Range	Input Voltage	Output Uncertainty	Null Accuracy*
10:0	0 to 100V	0.2 ppm	±0.5 μV
100:1	0 to 1000V	0.5 ppm	±1.0 μV

**Null accuracy refers to the required accuracy of the null detector reading during self-calibration*

Temperature Coefficient: 1±1 ppm per °C over range of 18°C to 28°C. Typically 0.1 ppm per °C from 15°C to 30°C

Input Resistance:

10:1 Ratio: 380 kΩ ±1%

100:1 Ratio: Divider is 4 MΩ Driven Guard is 4 MΩ; total is 2 MΩ ±1%

Maximum Input Voltage: 200V for the 10:1 ratio; 1100V for the 100:1 ratio

Power Coefficient: ≤0.05 ppm of output with 100V applied for 10:1 ratio and ≤0.3 ppm of output with 1000V applied for 100:1 ratio (included in the ratio accuracy specifications)

Temperature: 0°C to 50°C, operating; -40°C to 75°C non-operating

Relative Humidity: ≤75% to 40°C, ≤45% to 50°C, non-condensing, operating <100% 10-50°C, non operating

Altitude: ≤3050m (10,000 ft) operating; ≤12,200m (40,000 ft) non-operating

Vibration: Per MIL-T-28800C, Type III, Class 5, Style E

Safety: IEC 348, 2nd edition, 1978; ANSI-C39.5, 1980

Size: 19.1 cm H x 22.1 cm W x 60.3 cm L (7.53 in x 8.69 in x 23.75)

Weight: 8.4 kg (18.5 lb)

Included: Instruction manual

Ordering Information

Models	January 1989 prices
752A Reference Divider	$5190

Accessories (Also see page 485)

5440A-7002 Low Thermal Copper EMF Plug-in Cables	350
845AB Voltmeter/Null Detector w/battery pack	2490
845AR Voltmeter/Null Detector w/rack mount	2350

540B

(NSN 6625-00-288-0184) **540B**

540B Thermal Transfer Standard

- 100 ppm aV/dV transfer uncertainty
- Less than 100 ppm dc reversal error
- Frequency range 5 Hz-1 MHz (to 50 MHz with A55)
- Overvoltage protection
- Polarity reversal switch

The Fluke 540B is a thermal transfer instrument for precise measurement and calibration of alternating voltage and current. The 540B is designed for simple operation with positive protection from overloads. Voltage transfers may be made from 0.25V to 1000V rms in 14 ranges, with a frequency range from 5 Hz to 1 MHz. Each range maintains specified accuracy down to half of range. Resolution of input per scale division varies from 12 ppm at full range to 60 ppm at half of range. Basic aV to dV transfer uncertainty is 100 ppm (±0.01%) without the use of calibration curves or correction tables.

The thermal element in the 540B is a specially constructed vacuum thermocouple protected from overvoltage. Up to 1500V dc or rms ac may be applied on any range without damage. A pushbutton protection disable switch allows confirmation that diode aging in protection circuitry is not contributing to error.

Three galvanometer sensitivity settings are provided. A sensitivity test fundtion provides momentary galvanometer deflection for 0.1% and 0.01% of input voltage, at any galvanometer sensitivity setting.

The 540B includes a meter-display search function, for continuous visual indication of input percent of range. The search function indicates when the overload circuit has activated, by deflecting upscale into a red "overload" area. After an overload condition, the 540B is returned to normal operation simply by setting the mode switch to "off."

The basis of transfer comparison in the 540B is always 1:1; ac and dc voltages are placed across the same transfer circuit. In this way, accuracy is independent of range division ratios.

Dc reversal error in the thermocouple is less than 100 ppm (0.01% of input voltage. A convenient "push-to-reverse" switch is provided to reverse dc input polarity.

A high frequency thermal converter input jack is provided so Ithat the galvanometer and Lindeck reference supply may be used with Fluke Model A55 High Frequency Thermal Converters.

The 540B operates from rechargeable nickel-cadmium battery cells for complete isolation from line power. Fully charged, the 540B may be operated for up to 200 hours without an interuption for charging.

Calibration

Each range is adjusted to be within the specified deviations from zero error as defined by reference standards maintained by the Fluke Standards Laboratory and periodically calibrated by the U.S. National Bureau of Standards. These ac/dc difference figures do not include U.S. National Bureau of Standards' random and systematic errors. Fluke test reports to the nearest 100 ppm are aviliable at extra cost upon request.

Characterization

Model 540B-900 is a 72-point characterization of a new 540B Thermal Transfer Standard. Model 540B-901 is the same characterization service for a customer-owned 540B, available through Fluke Technical Service Centers. All characterizations are actually performed by the John Fluke Standard Laboratory in Everett, Washington. This 72-point characterization is intended to support customers who wish to characterize 5200A-800 Enhancement Software.

Special characterizations to meet specific calibration requirements are also available. Consult your local Fluke Sales Office for further information.

Specifications

Voltage Ranges: 0.5, 1, 2, 3, 5, 10, 20, 30, 50, 100, 200, 300, 400, and 1000V, with each range usable from 1/2 to 1 times rating

aV to dV Transfer Uncertainty

Frequency	Voltage Ranges			
Hz	0.5-10V	10-50V	100-500V	1000V
5-20k	±0.01%	±0.01%	±0.01%	±0.02
20k-50k	±0.01%	±0.01%	±0.01%	±0.04%
50k-100k	±0.5%	±0.05%	±0.20%	X
100k-500k	±0.10%	±0.10%	X	X
500-1M	±0.10%	X	X	X

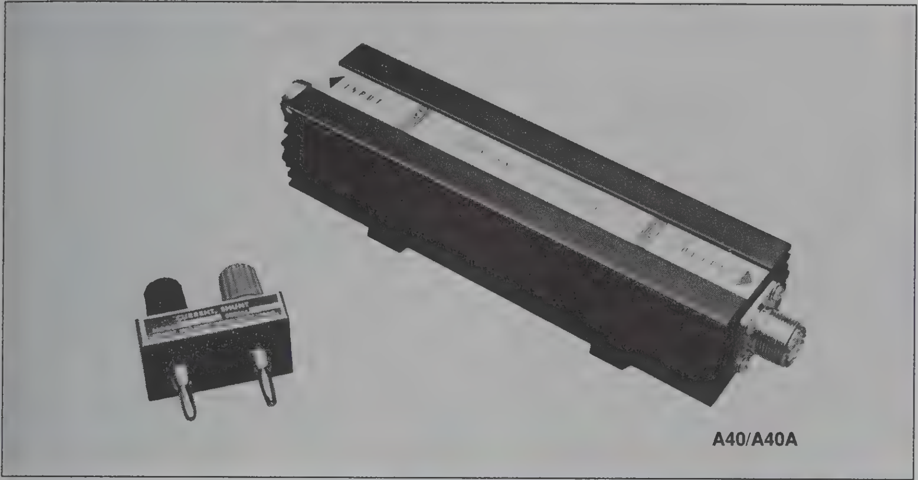
Search Function: Meter display of input as percentage of range
Input Impedance: 180Ω/V
Polarity: Reversible, front panel push-button
Galvanometer: Fluke electronic type
Galvanometer Resolution: 12 ppm of input/scale division at full range; 60 ppm of input/scale division at half range
Thermocouple Reversal Error: ≤100 ppm of input at full range; ≤300 ppm at half range
Overload Protection: Withstands up to 1500V dc or rms ac, any range
Power: 115V or 230V ac ±10%, 50 to 440 Hz, 7W; self-contained rechargeable batteries; 200 hours operation, 16 hours recharge time
Size: 17.2 cm H x 41.7 cm W x 19 cm D (in H x 17 in W x 7.75 in D)
Included: Instruction manual, A55 connecting cable

Ordering Information

Model	January 1989 prices
540B Thermal Transfer Standard	$5900

Accessories

540B-103 7" Rack Adapter	130
540B-110 Rechargeable Battery Pack (retrofit kit)	475
A40 Current Shunts	630
A40A Current Shunts	700
A55 High Frequency Thermal Converters	735



A40/A40A

A40 and A40A Current Shunts

- Ac current transfer measurements form 2.5 mA to 20a
- Frequency response from 5 Hz to 100 kHz
- Designed for use with Model 540B

Models A40 and A40A Current Shunts make possible accurate ac to dc current transfer measurements using the Model 540B Thermal Transfer Standard and a known dc source. Measurements may be made over a 2.5 milliampere to 20 ampere range with a frequency response from 5 Hz to 50 kHz. Measurements to 100 kHz may be made up to 5 amperes.

Twelve A40 Current shunts are available with current ratings from 10 milliamperes to 5 amperes. A40A shunts are availbel with current ratings of 10 and 20 amperes. Each shunt maintains specified accuracy down to half its rated current level. With no shunt in place, the 540B may be used directly ofr current transfer measurements from 2.5 milliamperes to 5 milliamperes.

A40 shunts plug into panel connectors on the 540B. A40A shunts require special cables, available separately.

Calibration

All ac to dc differences expressed in the specifications are deviations from dc standards maintained by the U.S. National Bureau of Standards, and may be obtained without the used of calibration curves or correction tables. When properly used with a Fluke 540B Thermal Transfer Standard, wach A40 and A40A Current Shunt is within the specified deviation from zero error, as defined by reference standards maintained by the John Fluke Standards Laboratory and periodically calibrated by the U.S. National Bureau of Standards. These ac to dc difference figures do not include U.S. National Bureau of Standards random and systematic errors. Fluke test reports to the nearest 100 ppm (0.01%) are available at extra cost upon request.

Specifications

A40 Current Ratings: 10, 20, 30, 50, 100, 200, 300, and 500 mA; 1, 2, 3, and 5A (RMS)
A40A Current Ratings: 10 and 20A (RMS)
Uncertainty

Frequency	AC to DC Difference	
	A40	A40A
5 Hz - 20 kHz	±0.02%	±0.03%
20 kHz - 50 kHz	±0.03%	±0.05%
50 kHz - 100 kHz	±0.05%	

Ordering Information

Models

January 1989 prices

A40* Current Shunts	$630
A40A* Current Shunts	700

Accessories (Also see page 485)

A45-4003 Input Cable for A40A Shunts	70
A45-4004 Output Cable for A40A Shunts	100
Y8133 Test Lead Kit for A40 Shunts	22
C41 Storage Cases	630

**National Stock Numbers are available for most A40 and A40A shunts. Contact your Fluke sales engineer for details.*

A55

A55 High Frequency Thermal Converters

Useable to 50 MHz

Designed for use with Model 540B

Model A55 Thermal Converters make possible accurate thermal-transfer aV to dV measurements form subaudio frequencies to the VHF region. The design is comparable to that of standards maintained by the U.S. National Bureau of Standards.

Designed for use with the Model 540B Thermal Transfer Standard, nine model A55 Thermal Transfer Standards are available to match each 540B voltage range from 0.5V to 50V. The 540B includes a compatible connector that bypasses its internal transfer circuit, kusing only the null detector and reference supply. Each A55 converter maintains specified accuracy down to half its rated voltage.

A specially constructed thermocouple, selected for frequency characteristics and low dV reversal error, is the thermally responsive element. Input voltage is applied directly across the thermocouple heater on the 0.5V model. For higher voltages, low termperature-coefficient coaxially mounted metal film series dropping resistors are used.

Certification

Each A55 converter includes a Fluke production test record of aV to dV differences at 1, 10, 20, and 30 MMHz. A55 converters rated below 20V also include a production test record of aV to dV difference at 50 MHz. Fluke test reports at other frequencies and voltages are available at extra cost upon reuqest. AV to dV differences are established to within ±100 ppm by comparison to Fluke standards that are periodically intercompared with the U.S. National Bureau of Standards.

Accessory Kit

The Model A55-110 Accessory Kit is recommended for use with A55 Thermal Converters in virtually any calibration or measurement setup. The kit includes:

- Coaxial tee for A55 inmput (GR type 874-TL).
- Three coaxial adapters for A55 input: UHF, BNC, and type N jack.
- Interconnecting coaxial cable, as cource to coaxial tee.

Specifications

Voltage Ratings: 0.5, 1, 2, 3, 5, 10, 20, 30 & 50V*
**Each converter is useable from 1/2 to 1 times its rated voltage (rms)*

Uncertainty:

Frequency	Calibration Uncertainty*	Typical aV to dV Difference
< 1 MHz		<±0.01%
1 MHz	±0.05%	±0.01%
10 MHz	±0.10%	±0.01%
20 MHz	±0.15%	±0.02%
30 MHz	±0.20%	±0.10%
50 MHz	±0.50%	±0.30%

* *All calibration is referenced to center of GR 874-TL coaxial tee attached to converter input connector*
***50 MHz calibraiton available only for 0.5, 1, 2, 3, 5, and 10V converters*

Input Impedance: 200Ω/V, approximate
Output Voltage: 7 mV nominal, at rated input
Output Resistance: 8Ω
Reversal Error: <250 ppm (0.025%)
Input Connector: GR type 874-TL
Output Connector: Amphenol 80-PC2M (2-pin microphone)
Size and Weight

Converters	Diameter cm	Length cm	Weight kg
0.5V	3.5	8.4	28
1V, 2V	3.5	13.2	370
3V, 5V	3.5	16.5	430
10V, 20V	3.5	17.9	450
30V, 50V	3.5	17.9	450

Included: Instruction manual and certification

Ordering Information

Model

January 1989 prices

A55* High Frequency Thermal Converter	$735

**Order by voltage rating, eg: A-55 -05V. Prices are for each converter*

Accessories (Also see page 485)

A55-110 Accessory Kit	735
C55 Storage Case	630

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-A55 Repair (w/calibration)	35
SC2-A55 Cal	135

**National Stock Numbers are available for most A55 Converters. See your Fluke sales engineer for details.*

510A

(NSN 6625-00-356-3085) **510A**

510A AC Reference Standard

- Uncertainty to ±100 ppm
- Optional battery operation
- Output voltage 10V rms
- Output current levels to 10 mA rms
- Fixed frequency, 50 Hz to 100 kHz

The 510A is a precision, fixed frequency, alternating voltage source designed for use as an amplitude calibration standard for test applications. In the calibration laboratory, the 510A provides an accurate aV reference for calibrating both true rms and average-sensing aV voltmeters. On the production line, the 510A can be used to rapidly verify aV test instrumentation or to generate a precise aV stimulus for circuit testing.

Output of the 510A is both fixed frequency and fixed amplitude. The frequency may be varied ±1% of center frequency with a front panel screwdriver adjustment.

Total harmonic distortion is less than 50 ppm up to 10 kHz, and less than 300 ppm at 10 kHz. This assures a pure sineware for calibrating average, peak, or true rms reading aV-to-dV converters.

The optional rechargeable battery pack provides up to 16 hours of operation independent of line power. A front panel display provides a continuous display of bettery condition. When operated from line power, the battery is maintained at full charge. The battery automatically operates the 510A whenever line power is removed.

Up to four 510As may be connected together for mounting in a standard rack. Output terminals are provided on both the front and rear panels for easy access in both bench and system applications.

Specifications

Technical Specifications

Output Voltage: 10V rms
Output Current: 10 mA rms, short-circuit protected
Frequency: Any specified single frequency from 50 Hz to 100 kHz Standard frequencies are: 50, 60, 400, 1000, 2400. 5000, 19,200, & 100,000 Hz
Amplitude Uncertainty:* ±ppm

Frequency	24 Hours	30 Days	90 Days
50 Hz-20 kHz	100	150	200
20 kHz-50 kHz	150	250	350
50 Hz-100 kHz	400	500	600

** After 10-minute warm-up in ambient temperature 21°C to 25°C*

Amplitude Stability: ±ppm

Frequency	24 Hours	30 Days	90 Days
50 Hz-20 kHz	20	50	100
20 kHz-100 kHz	40	100	200

Total Harmonic Distortion: Less than 50 ppm to 10 kHz; less than 300 ppm at 100 kHz
Center Frequency Uncertainty: ±0.1%, adjustable ±1%
Frequency Stability: 500 ppm per mo
Load Regulation: ≤20 ppm to 10 kHz; ≤80 ppm at 100 kHz
Line Regulation: ≤10 ppm for ±10% line change
Input Power: 115 or 230V ac ±10%, 50 to 500 Hz, or optional rechargeable batteries
Size: 8.8 cm H x 10.7 cm W x 30.4 cm D (3.5 in H x 4.25 in W x 12 in D)
Weight: 2.26 kg (5 lb)
Included: Instruction Manual, power cord, calibration certificate

Ordering Information

Models

January 1989 prices

510A* AC Reference Standard	$1790
510A-01* AC Reference Standard w/battery pack	1995
510A/SF* AC Reference Standard (Special Frequency)	on req
510A-01K Rechargeable Battery Pack (for retrofit)	375

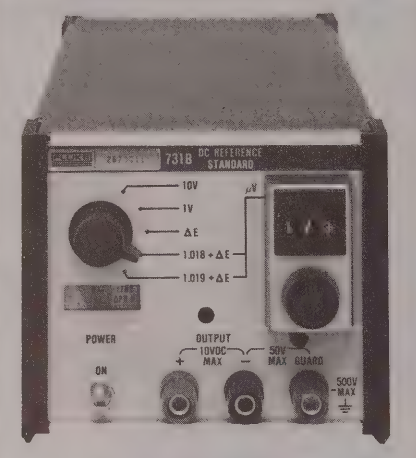
**Specify frequency when ordering*

Accessories (Also see page 485)

M03-201-601 Rack Mount Kit, Single	160
M03-202-603* Rack Mount Kit, Dual	110
M03-206-604* Rack Mount Kit, Triple	180
M03-205-605* Rack Mount Kit, Quad	105

**May be combined with the 731B*

731B & 721A



(NSN 6625-01-012-4638) **731B**

731B DV Reference Standard

- Outputs at 10, 1, 1.018, and delta E
- 10 ppm output accuracy
- Guarded floating output up to 500V above ground
- Line and battery powered

The Fluke Model 731B DC Reference Standard is a versatile instrument providing stability, while utilizing the excellent performance capabilities of solid-state technology. The instrument furnishes a variety of prevision voltages with switched output ranges including 1.0, 1.018 + ΔE, 10.0, and ΔE volts. Delta E (ΔE) provides a variable output of 0 through 999 μV which is either added to the voltage of a standard cell transfer or may be used directly as a low-level, stable direct voltage source.

Specifications

Output Ranges: 10V, 1V, 1.018 + ΔE, 1.019 + ΔE, ΔE
Output Accuracy:*

Range	30 Days	90 Days	1 Year
10V	±10 ppm	±15 ppm	±30 ppm
1V	±10 ppm	±15 ppm	±30 ppm
1.018+ΔE	±10 ppm	±15 ppm	±30 ppm
1.019+ΔE	±10 ppm	±15 ppm	±30 ppm
ΔE	—	—	±2 μV

**Absolute accuracy at 23°C ±1°C after 30 minutes warm-up*

Transfer Accuracy (Stability)

Between	4 Hours
Standard cells on 1.018V + ΔE ranges ranges or 1.019V + ΔE ranges	2 ppm
Standard cell and 1V output	3 ppm
10V output and standard cell or 1V output	5 ppm

Source Resistance: 10V range is <0.07Ω The 1V, 1.018V, 1.019V, and ΔE ranges are <1 kΩ
Output Protection: The output may be shorted indefinitely without damage to instrument
Line Regulation: <1 ppm for ±10% line voltage variation
Ripple & Noise: <1 ppm peak-to-peak 0 to 1 Hz, <20 μV rms 1 Hz to 1 MHz, except <70 μV rms at 10V output
Common Mode Noise Rejection: ≥120 dB at 0 Hz, ≥100 dB at 60 Hz, ≥85 dB at 400 Hz
Isolation: Output may be floated up to 500 dV between chassis ground and guard
Temperature: 0°C to 55°C, operating
Power: 115V or 230V ac ±10V, 50 to 400 Hz or internal rechargeable batteries, 6W max, 120 mA max
Size: 8.8 cm H x 10.7 cm W x 30.4 cm D (3.5 in x 4.5 x 12 in)
Weight: 2.26 kg (5 lb)
Included: Manual, power cord, batteries, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

731B DC Reference Standard	$1850

Accessories (Also see page 485)

M03-201-601	3" Rack Adapter, Single	160
M03-202-603	3" Rack Adapter, Dual	110
M03-206-604	3" Rack Adapter, Triple	180
M03-205-605	3" Rack Adapter, Quad	105

(NSN 6625-00-445-3330) **721A**

721A Lead Compensator

The 721A Lead Compensator equalizes the voltage drop across two resistive dividers connected in parallel for calibration. The errors due to contact and lead resistance are eliminated.

Specifications

Resolution of Resistance Compensation: 0.1 mΩ
Maximum Ratio Between Divider Resistance: 4000:1
Maximum Allowable Lead Resistance: 150 mΩ
Maximum Divider Voltage: 1500V dc
Size: 8.8 cm H x 48.2 cm W x 15.2 cm D (3 1/2 in x 19 in x 6 in)
Weight: 2.72 kg (6 lb)
Included: Manual

Ordering Information

Model

January 1989 prices

721A Lead Compensator	$1760

Service & Support

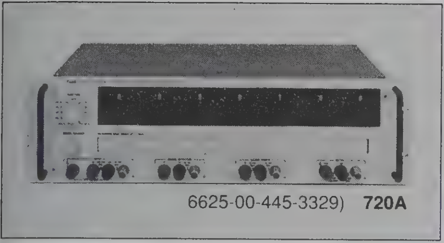
Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions

Extended Warranty

SC1-721A	Repair (w/calibration)	65
SC1-721A	Repair (cal w/in or out data)	80
SC1-721A	Repair (cal w/in and out data)	95
SC2-721A	Cal	31
SC2-721A	Cal (w/in or out data)	46
SC2-721A	Cal (w/in & out data)	61

720A & 750A


6625-00-445-3329) **720A**

720A Kelvin-Varley Divider

- 0.1 ppm resolution, seven decades
- 0.1 ppm of input absolute linearity
- Built-in self calibration bridge
- Front panel self calibration

Model 720A Kelvin-Varley Divider is a high-resolution primary ratio standard with absolute linearity of 0.1 ppm, temperature coefficient of linearity of 0.1 ppm/°C, and self-calibration capability.

Specifications

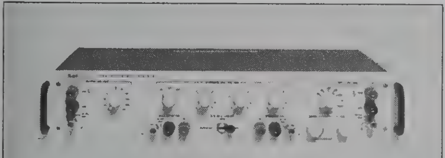
Ratio Range: 0 to 1.0 (1.0 input tap) and 0 to 1.1 (1.1 input tap)
Resolution: 0.1 ppm of input with seven decades
Absolute Linearity: (At calibration temperature and without the use of a correct chart) ±0.1 ppm of input at dial settings of 1.1 to 0.1, ±0.1 $(10S)^{1\ 3}$of input at dial settings (S) of 0.1 to 0
Absolute Linearity Stability: (Without self-calibration) ±1.0 ppm of input/yr at dial settings of 1.1 to 0.1, ±1.0 $(10S)^{2\ 3}$ ppm of input/yr at dial setting (S) of 0.1 to 0

NOTE: Absolute linearity is defined as the linearity between max and min output voltages. The self-calibration procedure may be used at any time to reset absolute linearity to ±0.1 ppm of input

Temperature Coefficient of Linearity: ±0.1 ppm of input/°C maximum at dial settings of 1.1 to 0.1
Short-Term Linearity Stability: Under typical conditions in a standards laboratory environment (temperature maintained within ±1 C) and with an applied voltage of up to 100V, stability of linearity is 0.1 ppm/30 days
Power Coefficient of Linearity: ±0.2 ppm of input/W max at dial settings of 1.1 to 0.1; ±0.2 $(10S)^2$ ppm of input/W max at dial settings (S) of 0.1 to 0
Maximum End Errors: Zero error at output low: 0.004 ppm of input. Zero error at input low: 0.05 ppm of input. Full-scale error: 0.05 ppm of input
Thermal Voltages: ±0.5 μV max
Maximum Input Voltage: 1000V on 1.0 input terminal, 1100V on 1.1 input terminal
Input Resistance: 100 kΩ ±0.005% at 1.0 input terminal at 25 C; 110 kΩ ±0.005% at 1.1 input terminal at 25 C
Temperature Coefficient of Input Resistance: ±1 ppm per C max
Size: 14 cm H x 48.2 cm W x 33 cm D, rack-mounted (5.5 in H x 19 in W x 13 in D)
Weight: 8.16 kg (18 lb)
Included: Manual

Ordering Information

Model	January 1989 prices
720A Kelvin-Varley Voltage Divider	$7290


(NSN 6625-00-445-3332) **750A**

750A Reference Divider

- 10 ppm basic division ratio accuracy
- Switched input and output ranges
- Built-in Kelvin-Varley Divider for standard cell reference
- Overvoltage protection to 2 kV, any range

Model 750A Reference Divider is an extremely accurate and stable voltage divider for calibration of precision meters, calibrators, etc. The instrument is a 10 ppm (0.001%) divider with switched input taps ranging from 1100 to 1.1V, and switched output taps ranging from 1100V to 0.1V.

Specifications

Input Voltages: (Switched) 1.1, 5, 10, 50, 100, 500, 1000, 1100V
Output Voltages: (Switched) 0.1, 0.5, 1, 1.1, 5, 10, 50, 100, 500, 1000, 1100V
Standardizing Output: 1.017000 to 1.019999 dV in 1 μV steps
Division Ratio Accuracy and Stability: (Referenced to Standard Cell tap) ±(0.001% of output +0.5 μV) for 1 year
Calibration: All ranges above 1.1V are adjustable ±10 ppm
Calibration Resolution: 0.2 ppm
Divider Current: 1 mA nominal
Input Current Adjust: Coarse and fine frontpanel rheostats provide an input voltage adjustment span of 10 mV with better than 1 μV resolution
Overvoltage Protection: Up to 2 kV may be applied on any range without damage
Power: Two 6.75V mercury batteries (1 year life)
Size: 8.8 cm H x 48.2 cm W x 33.0 cm D (3 in x 19 in x 13 in)
Weight: 7.25 kg (16 lb)

Ordering Information

Models	January 1989 prices
750A Reference Divider	$4990

Service & Support

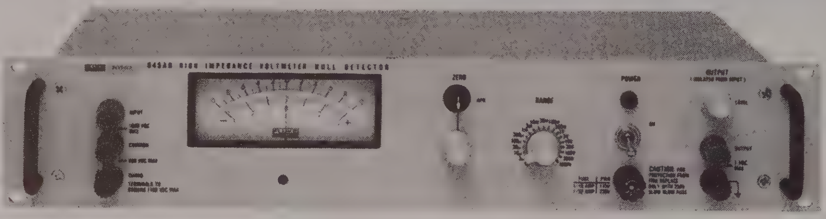
Warranty

One-year warranty. Calibration guaranteed during calibration cycle. (See page 470 for further information on warranty and calibration.)

Extended Warranty

SC2-720A Calibration	216
SC2-720A Calibration (w/incoming or outgoing data)	291
SC2-720A Calibration (w/incoming & outgoing data)	366

845AB & 845AR



(NSN 6625-00-257-7561) **845AR**

NSN 6625-00-226-3718 **845AB**

845AB & 845AR Null Detector

- 10 ranges from 1 µV through 1000V
- Input isolation greater than 10^{12} ohms
- Input may be floated to 1100V above ground
- Overload protected to 1100V on all ranges
- Recorder output isolated from input

The Fluke 845AB and 845AR are solid-state null detectors designed for extremely high input impedance, sensitivity, and isolation. Model 845AB operates either from the line or from built-in rechargeable batteries. Model 845AR is a line-powered rack-mounting version, with a height of 3 inches. Source loading through leakage is virtually eliminated by input isolation of 10^{12} ohms regardless of power line, chassis ground, or guard connections. Recorder output provides ±1V dc for end-scale deflection with ±0.5% linearity and does not affect input isolation. The 845AB and 845AR are capable of being floated up to 1100V dc from ground at either input terminal when used in a bridge circuit to compare voltage divider ratios. The unit with stands overloads up to 1100V dc on any range with a typical recovery time of four seconds.

Specifications

Range: 1 µV through 1000V dV end-scale in nineteen ranges, using 1, 3, 10 progression

Input Resistance: 100 MΩon 300 mV range and above. 10 MΩ on 3 mV through 100 mV range, 1 MΩ on 1 mV range and below

Accuracy: Model 845AB ±(2% end-scale +0.1 µV). Model 845AR ±(3% end-scale +0.1 µV)

Maximum P-P Meter Noise: 0.20 µV on 1 µV range, 0.25 µV on 3 µV range, 0.3 µV on 10 µV to 1000V range, with input shorted

Input Isolation: Better than 10^{12} ohms at ≤50% relative humidity and 25°C regardless of line, chassis, or recorder grounding. Better than 10^{10} ohms up to 80% relative humidity and 35°C. With driven guard, isolation improves to at least 10^{13} ohms. Either input terminal can be floated 1100V off chassis ground

DC Common Mode Rejection: Better than 160 dB, input short-circuited, ≤80% relative humidity; better than 140 dB, open-circuited, ≤50% relative humidity; better than 120 dB, open-circuited, ≤80% relative humidity

AC Common Mode Rejection: (Below 100 kHz) 100V rms or 120 dB greater than end-scale, whichever is less, will affect reading <2% of end-scale (input open-circuited)

AC Normal Mode Rejection: (60 Hz and above) ac voltages 60 dB above end-scale will affect reading <2% of end-scale. Maximum voltage not to exceed 750V rms

Recorder Output: ±1V dc at full scale deflection. Linearity, 0.5%. Output impedance, 5K to 7.5K. Recorder output is isolated from input and is referenced to ground

Stability of Zero: Better than 0.15 µV/hour; better than 0.3 µV/day

Overload Capability: Up to 1100V dc may be applied on any range. Typical recovery time is 4s

Power, Model 845AR: 115 or 230V ac ±10%, 50 to 440 Hz, approx. 3W

Power, Model 845AB: 115 or 230V ac ±10%, 50 to 440 Hz or rechargeable battery. Approximately 6W during recharge. 40 hr operation on full charge. Batteries trickle-charge while instrument operates from power line

Size, Model 845AB: 17.8 cm H x 21.6 cm W x 20.3 cm D (7 in H x 8.5 in W x 8 in D)

Size, Model 845AR: 8.9 cm H x 48.3 cm W x 21 cm D (3.5 in H x 19 in W x 8.25 in D)

Weight: Model 845AB: 4.65 kg (10.25 lb); Model 845AR: 4.08 kg (9 lb)

Ordering Information

Models

January 1989 prices

845AB Voltmeter/Null Detector w/batteries	$2490
845AR Voltmeter/Null Detector	2350

Accessories (Also see page 485)

881A-102 7" Rack Adapter, Single, for 845AB	175
881A-103 7" Rack Adapter, Dual, for 845AB	120
5440A-7002 Low Thermal Copper EMF Plug-in Cables	350

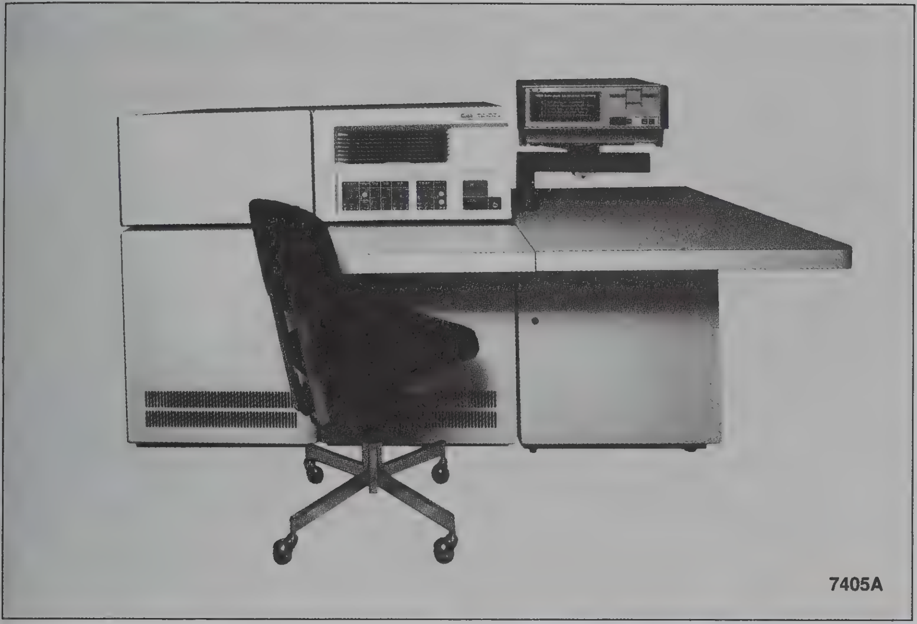
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-845AB/AR Repair (w/calibration)	130
SC1-845AB/AR Repair (cal w/in or out data)	165
SC1-845AB/AR Repair (cal w/in and out data)	200
SC2-845AB/AR Cal	50
SC2-845AB/AR Cal (w/in or out data)	85
SC2-845AB/AR Cal (w/in an out data	120



7405A

7405A Multimeter Calibration Workstation

The 7405A is a fully automated, precision calibration workstation. It can rapidly and accurately calibrate a wide range of meters including DMMs, DVMs, VTVMs, and VOMs as well as voltage and current sources, power supplies, amplifiers, and passive devices.

A basic 7405A is comprised of a fully integrated group of Fluke measurement and calibration instruments - the 5100B Multifunction Calibrator, the 8505A Digital Multimeter, and the 1722A Instrument Controller - built into a console having a single unique Test Interface Panel. Switching circuitry in the test panel provides functional self tests. Innovative software combined with the test panel enhances the 7405A accuracy.

7410A Oscilloscope Calibration Workstation

The Fluke 7410A is a fully integrated, automated calibration workstation which rapidly and accurately calibrates oscilloscopes of any manufacturer. It also verfies and calibrates plug-ins, probes, amplifiers, calibration fixtures, and related devices. The 7410A can be customized by the user to accommodate additional workloads.

The Fluke 7410A combines the powerful 1722A Instrument Controller with the Tektronix CG5001 Programmable Calibration Generator and the Fluke 8520A DMM. Other Fluke instrumentation provides additional measurement and stimulus capability to address the bulk of scope workload.

Ordering Information

Model	January 1989 prices
7405A Automated Calibration Workstation NSN 6625-01-225-3251	$61,500

Options

7405A-100 Precision Power Amplifier (req both -150 and -500 Options)	11,875
7405A-120 Transconductance Amplifier (req both -150 and -500 Options)	6,175
7405A-150 5100 Series Interface	650
7405A-200 Frequency Counter/Timer	3,075
7405A-500 Rack with Cabinet	4,395
7405A-501 Same as -500, but 230V version	on req
7400A-520 Controller Workstation	2,495

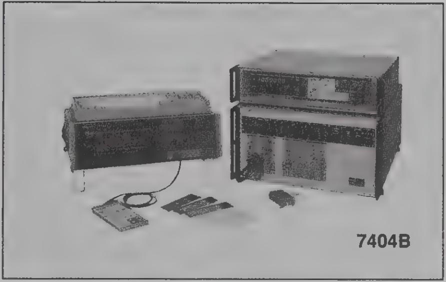
Model	January 1989 prices
7410A Automated Calibration Workstation	$63,412

Options

7410A-211 w/6011A Signal Source	6600
7410A-260 w/6060B Signal Generator	6034
7410A-270 w/6070A Signal Source	18,645
7410/A-271 w/6071A Signal Source	21,995
80K-40 High Voltage Probe	85
7400A-520 Workstation Table	2495

Accessories

Y1706 Pack of 10 Blank Disks	60



7404B

The 7404B Computer-Aided Calibration Cluster is an automated, highly accurate meter calibration system. It allows you to quickly and accurately calibrate digital and analog meters, power supplies, and other electronic instruments. The 7404B combines field-proven Fluke hardware and state-of-the-art 7411B Calibration Software in a system designed for reliability, durability, and performance that will meet your most stringent demands. Hardware combines the Fluke 5100B Multifunction Calibrator and 8506A Digital Multimeter under the control of the 1722A Instrument Contoller; the 1722A runs the 7411B Calibration Software.

Ordering Information

Model	January 1989 prices
7404B Computer-Aided Meter Calibration Cluster	$30,560

Options

5100A-03 Wideband AC Voltage for 5100B & 5101B	on req
8505A-02A* Ohms Converter	550
8500A-03* Current Converter	550
5202A Precision Power Amplifier for aV and dV (requires Y5000 and Y5001 in 5100B)	on req
5215A Precision Power Amplifier for aV (requires Y5000 and Y5002 in 5100B)	on req
5220A Transconductance Amplifier (requires Y5000 and Y5002 in 5100B)	5,650
17XXA-008 IEEE-488/RS232C Interface for 1722A	850

**Cannot install both -02A and -03 in 8506A at the same time*

8

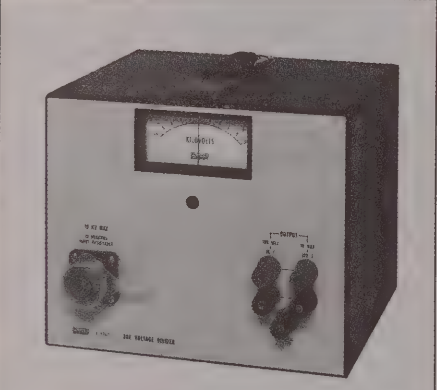
High Voltage Power Supplies

(NSN 4931-00-115-0567) **410B**

The 410B and 415B are extremely stable dc sources that cover the range of 0 to 10,000V with 5 mV resolution and 0.25% calibration accuracy. The 410B provides 0 to ±10,000V at 10 mA maximum output current. The 415B covers from 0 to ±3100V at 30 mA maximum. Both models include adjustable over-current protection.

410B High Voltage Power Supply	$5,450
415B High Voltage Power Supply	3,950

80E-10 High Voltage Divider



(NSN 6625-00-459-3219) **80E-10**

The 80E-10 is a voltage divider designed for use with voltmeters in measuring up to 10,000V dc. Divider outputs at 10V and 1V are proportional to 10 kV dc input and are accurate to ±0.01%. High measurement stability and accuracy are assured through the use of Fluke manufactured precision wire-wound resistors mounted on glass-epoxy printed circuit boards.

80E-10 High Voltage Divider	$1,325

(NSN 6625-00-492-5385) **7105A**

dV Calibration and Ratio System

- Cost-effective, high accuracy calibration
- Self-calibrating
- Expandable for aV calibration

The 7105A is a calibration system composed of five Fluke standards-type instruments mounted in a single benchtop cabinet. The 7105A is well known world-wide and is used extensively by electronic and electrical equipment manufacturers and government facilities.

Although the system is strictly for calibrating direct voltage sources, direct voltage meters, and the direct voltage value of resistors and dividers, the dV capabilities may be extended to aV calibration and measurement through the use of Fluke thermal transfer standards 540B, A55, A40, and A40A.

The instruments comprising the 7105A are:

Model 335A DC Voltage Standard/ Null Detector	$11,450
Model 845AR High Impedance Voltmeter/Null Detector	2,350
Model 750A Reference Divider	4,990
Model 720A Kelvin-Varley Divider	7,290
Model 721A Lead Compensator	1,760

Applications

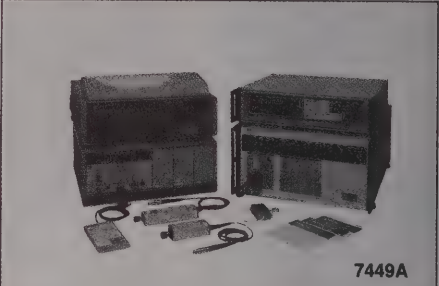
The 7105A can be used to calibrate dV calibrators and voltmeters to 0.5 ppm relative uncertainty. It can also be used to calibrate voltage dividers to 0.1 ppm of input total uncertainty. As a differential voltmeter, the 7105A can be used up to 0.5 ppm relative uncertainty and 0.1 ppm resolution.

Ordering Information

Models

January 1989 prices

7105A dV Calibration System (includes 7105A-502)	$27,870
7105A-502K Cabinet, w/gold flashed low, thermal leads, accessories, 115V ...	1,680
7105A/AA Cabinet, w/gold flashed low thermal leads, accessories, 230V ...	on req



7449A

The Fluke 7449A Computer-Aided Oscilloscope/Meter Calibration Cluster adds oscilloscope calibration capability to the already impressive line up of capabilities of the Fluke 7404B Calibration Cluster. With the 7449A you get calibration and verification capability of oscilloscope vertical gain, horizontal timing and gain, vertical pulse characteristics, probe accuracy and compensation, current probe accuracy, and calibrator output accuracy along with up to six functions for meter calibration and reliable measurement capability. In the 7449A, instrumentation joins flexible software to give you combined oscilloscope/meter calibration on which you can depend.

Ordering Information

Model

January 1989 prices

7449A Computer-Aided Oscilloscope/ Meter Calibration Cluster	$50,520

Options

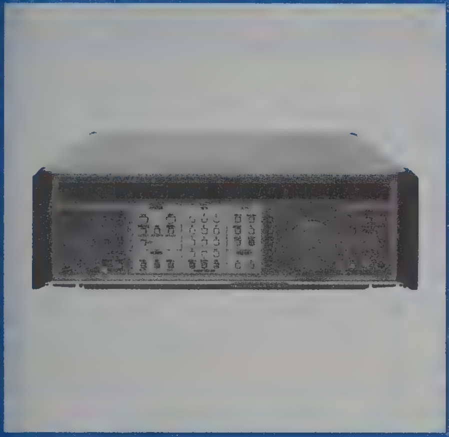
17XX-008 IEEE-488/RS232C Interface for 1722A	850

See previous page for 7404B options

Available Separately

7410A-400 Tektronix CG5001 Oscilloscope Calibrator	21,956

Signal Sources


Page 254 6070A

Page 246 6062A

Page 263 PM 5193

Page 277 PM 5134

Page 290 PM 5785

Page 297 PM 5715

From ultra high frequency L-Band application to low-frequency mechanical testing, Fluke and Philips offer signal sources to fit your budget and performance needs. Fluke and Philips sources include:

- RF Signal Generators (10 Hz to 2100 MHz)
- RC + Function Generators (0.1 to 50 MHz)
- Pulse Generators (0.1 Hz to 125 MHz)
- Television Pattern Generators

Fluke's 6060 Series of Synthesized Signal Generators provide excellent spectral purity and amplitude accuracy at frequencies up to 2100 MHz. Simple, solid construction provides excellent performance with high reliability and minimum downtime.

Philips PM 5110 low distortion RC generators provide low distortion audio signals at a price that is well within the budget of small service labs as well as educational institutions. At the other end of the performance spectrum is the PM 5193 Synthesized Function generator. This model combines a full-featured 50 MHz function generator (including sweep and internal and external AM and FM), with a 3 ns rise-time pulse generator.

Philips pulse generators are used for pulse response measurements in design and service applications. The PM 5785 and PM 5786 feature a simple front panel layout, supplemented by "Time Setting Error" indicators.

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Synthesized RF Signal Generators 246
Function Generators 263
Pulse Generators 290
Video & Audio Generators 301
TV & Video Pattern Generators 307

Signal Sources

Selection Guides

Synthesized RF Signal Generators

Models	Frequency			Amplitude			Modulation					Purity				SSB Noise			Res FM	Miscellaneous						Page
	Minimum	Maximum	Resolution	Minimum	Maximum	Resolution	Int. Source	AM/ FM	ø Modulation	Combination	Pulse	Harmonics	Sub-Harmonics	Spurious	Line Spurious	For 1 Hz BW	At Frequency	With Offset	RMS 15kHz BW at 500 MHz	Switching Time	Rev. Pwr. Protect	Rel. Ampl. &	Digital Sweep	Audio Out	IEEE-488 I/F	
	kHz	MHz	Hz	dBm	dBm	dBm						dBc*	dBc*	dBc*	dBc*	dBc*	MHz	kHz	Hz	ms						
6011A	0.01	11	0.1/10	-55	+27	0.01		Opt				-40	–	-60	–	-106	11	20	–	2/34		•			Opt	260
6060B/AK [1]	10	1050	10	-127	+13	0.1	•	•		•		-30	–	-60	–	-116	500	20	12	100	•	•			Opt	252
6060A/AN [2]	10	520	10	-127	+13	0.1	•	•		•		-30	–	-35	–	-113	500	20	15	100	•	•			•	250
6060B	10	1050	10	-127	+13	0.1	•	•		•		-30	–	-60	–	-116	500	20	10	100	•	•			Opt	246
6061A	10	1050	10	-127	+13	0.1	•	•		•		-30	–	-60	–	-123	500	20	6	100	•	•			•	246
6062A	100	2100	10/20	-127	+13	0.1	•	•	•	•	•	-30	-45	-54	–	-123	500	20	6	100	•	•			•	246
6070A	200	520	1	-127	+19	0.1	•	•	•	•	Opt	-35	–	-90	-56	-132	500	20	2.5	85	Opt	•	•	•	•	254
6071A	200	1040	1/2	-127	+19	0.1	•	•	•	•		-25	-35	-84	-50	-132	500	20	2.5	85	Opt	•	•	•	•	254
6160B	1000	160	0.1/1	+3	+13	Vac						-30	–	-83	–	-121	160	32	–	0.8					Opt	258

*– Not applicable or insignificant •Yes *At maximum carrier frequency (1) For pager and communications testing (2) Includes FM deviation meter*

Function Generators

Models	Frequency Range	Setting Error	Output Vp-p	DC Offset	Waveforms						Variable Duty Cycle	Output Characteristics			Sweep				Burst	Single	Gating	Int	Ext	IEEE / IEC	Pg
															Linear		Log								
	Hz-MHz				∿	⊓	⋀	1) ⊓	⟋	∩		600Ω	50Ω	TTL	Int	Ext	Int	Ext				AM	FM		
PM 5109	10-0.1	±5%	30		•	•						•	•	•											288
PM 5110	10-0.1	4%	6		•	•						•		•											287
PM 5131	0.1-2	10%	30	•	•	•	•						•	•			•	•							285
PM 5132	0.1-2	2%	30	•	•	•	•	•			•	•	•	•	•	•									283
PM 5133***	0.01-2	3%	20	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•			•		280
PM 5134*	0.001-20	5%	20	•	•	•	•	•			•	•	•	•	•	•			•	•		•	•		277
PM 5190	0.001-2	1ppm	20	•	•	•	•						•	•								•		IEC	274
PM 5191	0.0001-2	1ppm	30	•	•	•	•		•				•	•								•		IEEE	271
PM 5192	0.0001-20	1ppm	20	•	•	•	•		•				•	•	•	•	•	•			•	•	•	IEEE	268
PM 5193**	0.0001-50	1ppm	20	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	IEEE	263

**PM 5134 also provides crystal mode and crystal AM mode **PM 5193 includes 3 ns pulse generator 1) positive and negative ***PM 5133S adds audio sweep output*

6060 Series Option Compatibility

Option	Description	6060A	6060A/AN	6060B	6060B/AK	6061A	6062A
6060A-130	Most Accurate Timebase	–	–	1	1	1	1
6060B-132	Second Best Timebase	–	–	1	1	1	1
6060B-488	IEEE-488 Interface	–	#	•	•	#	#
6060A-488K	IEEE-488 Interface Kit	•	–	–	–	–	–
6060B-488K	IEEE-488 Interface Kit	–	–	•	•	–	–
6060A-570K	Non-Volatile Memory	•	–	–	–	–	–
6060A-651	Low-Rate FM	–	–	•	*	–	•
6060B-651	Low-Rate FM	–	–	–	*	•	–
6060B-830	Rear Output	–	–	•	•	•	–
6062A-830	Rear Output	–	–	–	–	–	•
Other Items							
Y6001	Rack Kit w/24" Slides	•	•	•	•	•	•

Notes: All options are customer-installable except where noted.

• Compatible option

#Option included

** Feature included*

1 Factory installation only. Only one timebase installed in one instrument

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Selection Guides

Pulse Generators

Model	Transition Time	Duration	Max. Frequency	Operating Modes			External Control					Outputs					Pg
				Squarewave	Double Pulse	Counted Burst	External Trigger	Var. Trigger Level	Var. Delay	External Duration	External Gate	Amp. (50Ω load)	Offset (50Ω load)	Pulse Outputs	Sync (Clock)	TTL	
PM 5785	1,1.5, 2ns	3.5ns to 100ms	125 MHz	•	•	Opt	•	•	8ns to 100ms	•	•	0.2V to 5V	-2.5V to +2.5V	A,B	•		290
PM 5786	2ns to 0.1s	3.5ns to 100ms	125 MHz	•	•	Opt	•	•	8ns to 100ms	•	•	0.2V to 5V	-2.5V to +2.5V	A,B	•		290
PM 5712	4ns	10ns to 100ms	50 MHz	•	•		•		10ns to 100ms	•	•	0.2V to 10V	-5V to +2V	A	•	•	297
PM 5715	6ns to 0.5s	10ns to 100ms	50 MHz	•	•		•		10ns to 100ms	•	•	0.2V to 10V	-5V to +2.5V	A	•	•	297
PM 5716	6ns to 0.1s	10ns to 100ms	50 MHz	•	•		•	•	10ns to 100ms	•	•	2V to 20V	(1)	A	• (2 outputs)		294
PM 5705	<10ns	50ns to 500ms	10 MHz	•			•			•		+1V to +15V	0V to 2V	A		• (2 outputs)	299

Note 1: Amplitudes may be set within -20V to +20V window.

TV and Audio Generators

Models	Frequency			Amplitude			Modulation			Purity		SSB ø Noise			Res FM	Miscellaneous			Pg
	Minimum	Maximum	Resolution	Minimum	Maximum	Resolution	Int. Source	AM/FM	Video	Harmonics	Spurious	For 1 Hz BW	At Frequency	With Offset	RMS, 15kHz BW at 500	Switching Time	Digital Sweep	IEEE-488 I/F	
	kHz	MHz	Hz	dBm	dBm	dBm				dBc*	dBc*	dBc	MHz	kHz	Hz	ms			
PM 5390	100	1020	1k/10k	-127	-7	(1)	•	•	•	-30	-30	-100	340	20	75	100	•	•	301
PM 5390S	100	1020	1k/10k	-127	+13	(1)	•	•	•	-20	-30	-100	340	20	75	100	•	•	301
PM 5326**	100	125	10.10k	–	(1)	–	•	•	•	–	–	–	–	–	–	–	•		305

*– Not applicable or insignificant • Yes *At maximum carrier frequency (1) Max output 50 mV at 75Ω. Continuous attenuation to -80 dB*
***PM 5326X adds counter facility*

TV and Video Pattern Generators

Model	Color and Monochrome TV	PAL	NTSC	SECAM	VCR/VLP	Video Monitors	Page
PM 5514V		•	•		•	•	315
PM 5515	•	•	•		•		307
PM 5518	•		•	•	•		307

Terms used in Signal Sources

dBc: The ratio (in dB) between two signals, where the reference signal is considered the "carrier". Useful for expressing relative levels for noise or spurious products on a signal generator's output signal, in terms of db below the carrier.

Incidental AM: Unwanted amplitude modulation that occurs when frequency modulating. Seldom a significant problem in modern signal generators.

Modulation Depth: Refers to amount of modulation, or "loudness" in audio terms. In FM and PM, modulation depth is determined by deviation; in AM it is determined by the percent of modulation.

Phase Noise: Short-term, random phase variations of an RF signal, a result of electrical noise in the signal generator's circuits. Expressed in dBc/Hz, which is noise density in a 1Hz equivalent bandwidth, relative to the carrier amplitude.

Residual FM: A measure of FM noise (short-term instabilities) of a signal generator's output, as measured with an FM modulatin meter. It is a key specification when a generator is used for testing FM radios.

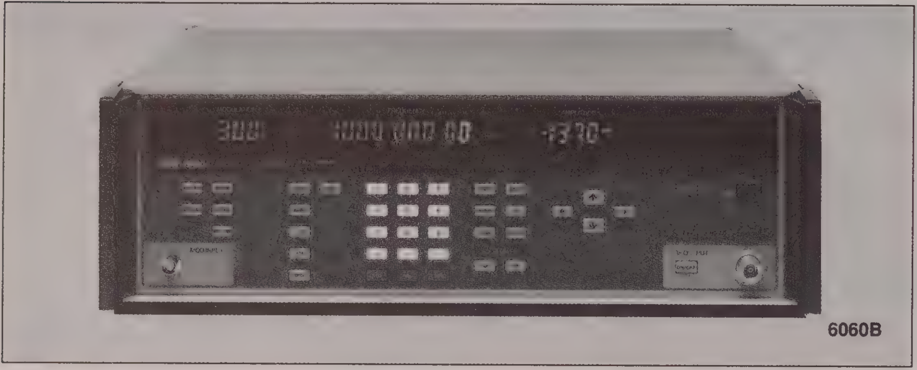
Spectral Purity: A general term used to refer to the cleanliness of an RF signal...its freedom from contamination by noise and spurious signals.

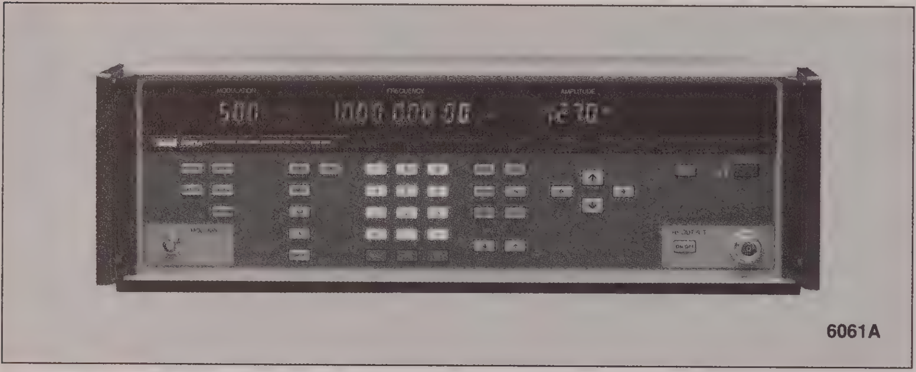
Spurious: Unwanted discrete frequencies present on the output of a signal generator, measured relative to carrier level in dBc. Usually this term is taken to mean the "non-harmonic" spurious specification for a signal generator. Therefore, the spurious specification for the 6060B is -60 dBc. In the more general sense, spurious refers to all undesired, discrete (non-random) outputs from a signal generator, including additionally harmonics, sub-harmonics, and line-related products.

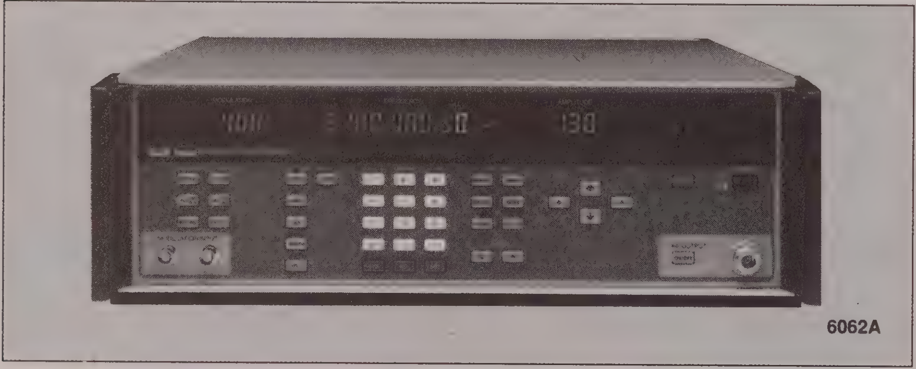
SSB Phase Noise: A plot of the phase noise spectrum of one side of an RF signal. (The two sides should be symmetrical.)

6060B, 6061A & 6062A

GPIB
IEEE-488


6060B


6061A


6062A

6060 Series: Synthesized RF Signal Generators
.01 to 1050 MHz and 0.1 to 2100 MHz
±1 dB amplitude accuracy to 1 GHz and ±1.5 dB accuracy to 2100 MHz (6062A)
Non-harmonic spurious -60 dBc to 1050 MHz
GPIB/IEEE-488
Built-in diagnostics and error code display
Reverse power protection
50 location non-volatile memory
Relative frequency and amplitude modes
Bright-digit editing

Economy and Performance

The Fluke 6060 Series is a family of fully programmable, synthesized signal generators covering 10 kHz to 2100 MHz.

The 6060B is an economical solution for most general purpose RF testing needs. The 6061A is equivalent to the 6060B, but has superior noise performance, making it desirable for receiver testing. These generators have output frequency selectable in 10 Hz steps from 10 kHz to 1050 MHz. Non-harmonic spurious products are less than -60 dBc, and harmonics less than -30 dBc. Level is programmable in 0.1 dB steps over the range -147 to +13 dBm, with overrange to +19 dBm. Accuracy is guaranteed ±1 dB in the range -127 dBm to +13 dBm.

The 6062A spans 100 kHz to 2100 MHz in 20 Hz steps (10 Hz steps below 1050 MHz). Specified amplitude accuracy is ±1.5 dB from -127 dBm to +13 dBm. Like its lower frequency family members, it has amplitude and frequency modulation. Also, the 6062A has phase modulation and fast-rise pulse modulation.

High-performance Pulse Modulation in the 6062A

The 6062A's gallium arsenide pulse modulator generates fast, high quality pulses for testing of pulsed communication and navigation circuits. It employs a design that can generate very narrow pulses, limited only by the modulator's 15 nanosecond rise and fall time.

Microprocessor Control

Microprocessor technology gives the 6060 family sophisticated operator functions including:

Keyboard Parameter Entry and Fluke **Bright-digit Editing.**

Increment Step Function, to allow an operator to vary frequency, amplitude, or modulation in specific increments.

Memory Store and Recall, for fifty complete front panel set-ups with internal non-volatile memory.

Relative Amplitude allows compensation for cable loss in test set-ups.

Relative Frequency speeds testing of frequencies relative to a reference, during filter testing or receiver selectivity measurements.

Self-Test Capabilities

Built-in diagnostics and error code displays provide immediate feedback of incorrect operation. Also, the generators perform a series of internal digital and analog tests at power-up and isolate problem areas immediately via a coded display on the front panel. These internal checks may be accessed and initiated at any time from the front panel. Special service and troubleshooting test routines are contained within the unit to aid in calibration and maintenance.

Options Summary

The GPIB/IEEE-488* interface is optional on the 6060B (Option 488), and is included as standard equipment on the 6061A and 6062A. The generators come with a 10 MHz free-air crystal reference oscillator, or may be fitted with one of two oven oscillator references: the high stability reference (Option -130) with $\pm5x10^{-10}$/ day aging rate, or a medium stability reference (Option -132) with $\pm1x10^{-7}$/month aging. Other options are rear output (Option -850), and low-rate FM (Option -651).

6060B General Purpose 1 GHz Signal Generator

- 10 kHz to 1050 MHz, 10 Hz resolution
- -127 to +13 dBm output, plus overrange
- 1 dB amplitude accuracy
- 0.1 dB resolution
- Non-harmonic spurious -60 dBc
- IEEE-488 (optional)
- Reverse power protection
- Non-volatile memory
- Relative frequency and amplitude modes

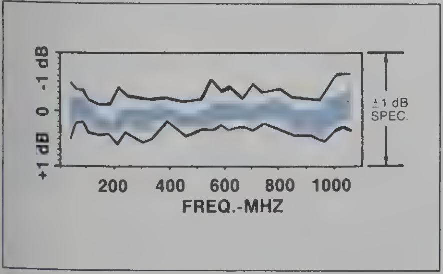
6061A Low-Noise Performance

- All features of the 6060B, plus:
- IEEE-488 included standard
- Lower SSB phase noise: typical -123 dBc/Hz at 20 kHz offset from 500 MHz carrier
- Lower Residual FM: 12 Hz rms at 1000 MHz

6062A 2.1 GHz General Purpose Signal Generator

- Contains all the features of the 6060B and 6061A
- Incorporates the low-noise improvements of the 6061A
- Adds these new features:
- Frequency coverage from 0.1 to 2100 MHz Phase modulation
- Fast-rise pulse modulation
- AC/DC-coupled AM
- 400 kHz FM deviation on 1050 to 2100 MHz range
- On-site manual or automated calibration
- IEEE-488 included standard

Typical Level Accuracy vs. Frequency for 6060B, measured at -127 dBm



The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

Specifications

Technical Specifications

Frequency

Range: .01 to 1050 MHz (6060B and 6061A); .1 to 2100 MHz (6062A)
Resolution: 10 Hz to 1050 MHz, 20 Hz from 1050 to 2100 MHz (6062A only)
Switching Speed: <100 ms to be within 100 Hz of final frequency
Accuracy & Stability: Same as Reference Oscillator

Reference Oscillator

Internal Reference Oscillator Characteristics

Characteristic	Standard, Free-Air Crystal	-132 Option, Medium Stability Oven	-130Option, High Stability Oven
Frequency	10 MHz	10 MHz	10 MHz
Temperature	$<\pm5x10^{-6}$ total, 0-50°C	$<\pm1x10^{-7}$ total, 0-50°C	$<\pm2x10^{-10}$ /°C 0-50°C
Aging Rate	$<\pm5x10^{-7}$ /mo	$<\pm1x10^{-7}$ /mo	$<\pm5x10^{-10}$ day $<\pm1.5x10^{-8}$ /mo
Warm-up (typical)	1 hr to within 1 ppm of final frequency	20 min to within $<\pm3x10^{-8}$ of final frequency	30 min to within $<\pm1x10^{-8}$ of final frequency

Reference Output

Frequency: 10 MHz, sinewave
Level: 0 dBm min into 50 Ωs
Source Impedance: 50 Ωs nominal

External Reference

Input Frequency: 1, 2, 2.5, 5, 10 MHz
Input Level: .3 to 4V pk-pk, sinewave or square-wave
Input Impedance: 50 Ωs nominal

Spectral Purity

Harmonics:

Amplitude	6060B and 6061A	6062A
+13 to +16 dBm	N/A	-25 dBc
>+13 dBm	-30 dBc (freq. >100 kHz)	-30 dBc (freq. >1 MHz)
	-26 dBc (10-100 kHz)	-25 dBc (0.1-1 MHz)

Subharmonics:

Carrier Frequency	6060B and 6061A	6062A
Below 1050 MHz	None	None
1050 to 2100 MHz	N/A	-45 dBc

Non-Harmonic Spurious:

Output Frequency	6060B and 6061A	6062A
10 kHz to 100 kHz	-55 dBc	N/A
.1 to 1050 MHz	-60 dBc	-60 dBc
1050 to 2100 MHz	N/A	-54 dBc

For offsets >10 kHz from carrier, cw mode

Residual FM (Hz rms) in 0.3 to 3 kHz BW:

Frequency Range	6060B	6061A		6062A	
	(Spec)	(Spec)	(typ.)	(Spec)	(typ.)
Below 245 MHz	20	12	8	12	8
245 to 512 MHz	10	6	4	6	4
512 to 1050 MHz	20	12	8	12	8
1050 to 2100 MHz	N/A	N/A	N/A	24	16

** Residual FM specifications for 6060B apply for temperature 25°C ±5°C. 6061A and 6062A specifications apply for full 0° to 50°C range.*

Residual FM (Hz rms) in .05 to 15 kHz BW:

Frequency Range	6060B	6061A		6062A	
	(Spec)	(Spec)	(typ.)	(Spec)	(typ.)
Below 245 MHz	44	18	12	18	12
245 to 512 MHz	22	9	6	9	6
512 to 1050 MHz	44	18	12	18	12
1050 to 2100 MHz	N/A	N/A	N/A	36	24

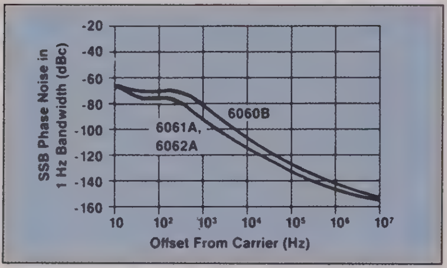
Residual FM (Hz rms) CCITT:

Frequency Range	6060B	6061A		6062A	
		(Spec)	(typ.)	(Spec)	(typ.)
Below 245 MHz	Not Specified	10	7	10	7
245 to 512 MHz		5	3.5	5	3.5
512 to 1050 MHz		10	7	10	7
1050 to 2100 MHz		N/A	N/A	20	14

Residual AM in .05 to 15 kHz BW: <0.1% rms (-60 dBc)

6060B, 6061A & 6062A

Typical SSB Phase Noise @ 500 MHz (with internal reference)



Amplitude Range: 6060B and 6061A: -127 to +13 dBm (+13 dBm peak on AM), with overrange to +19 dBm and underrange to -147 dBm. 6062A: -137 to +16 dBm (+16 dBm peak on AM) to 1050 MHz, to +13 dBm (+13 dBm peak on AM) above 1050 MHz. Overrange to +17 dBm and underrange to -147 dBm

Resolution: 0.1 dB

Annunciators: 6060B and 6061A: dB, dBm, V, mV, µV; 6062A: dB, dBm, V, mV, µV, dB µV, dB mv

Amplitude Accuracy: 25°C ±5°C

6060B and 6061A

Amplitude Range	10 kHz to 400 kHz	400 kHz to 1050 MHz
+13 to -100 dBm	±2 dB	±1 dB
-100 to -127 dBm	±3 dB	±1 dB

6062A

Amplitude Range	1 MHz to 1050 MHz	1050 kHz to 2100 MHz
+16 to -127 dBm	±1.0 dB	N/A
+13 to -127 dBm	±1.0 dBm	±1.5 dB

Amplitude Accuracy: 0°C to 50°C

6060B and 6061A

Amplitude Range	400 kHz to 1050 MHz
+13 to -127 dBm	±1.5 dB

6062A

Amplitude Range	100 kHz to 1 MHz	1 to 1050 MHz	1050 to 2100 MHz
+16 to +13 dBm	±2 dB	±1.5 dB	N/A
+13 to -127 dBm	±2 dB	±1.5 dB	±1.5 dB

Output Impedance: 150 Ωs, nominal

Output VSWR:
<1.5:1 for amplitude <+1 dBm
<2.0:1 for amplitude >+1 dBm

Reverse Power Protection: 6060B and 6061A: 50W RF from a 50Ω source, 10 kHz to 1050 MHz. Will withstand up to 50V dc. 6062A: 25W RF from a 50Ω source; up to 30V dc

Trip/Reset: Flashing RF OFF annunciator indicates when Reverse Power Protection circuit is tripped. Pushing RF ON/OFF button will reset generator. The 6062A is protected when the instrument is off; the 6060B and 6061A are not.

Leakage:

	6060B	6061A	6062A
RF Leakage at Carrier Frequency	1 µ V	0.5 µ V	1 µ V

Supplemental Characteristics

Amplitude Switching Speed: <100 ms typical (within 0.1 dB of selected value)

Level Flatness: ±0.5 dB (6060B and 6061A)

Amplitude Modulation

AM Depth: 0 to 99% in 1% steps

AM Accuracy: (6060B and 6061A)
±(2% + 4% of setting)

AM Accuracy: (6062A)
±(3% + 5% of setting), 0.1 to 1 MHz, to +16 dBm pk
±(2% + 4% of setting), 1 to 1050 MHz, to +16 dBm pk
±(2% + 4% of setting), 1050 to 2100 MHz, to +13 dBm pk

AM Distortion: 6060B and 6061A

AM Depth	10 kHz to 1050 MHz
0 to 30% AM	<1.5% THD
30 to 70% AM	<3% THD
70 to 90% AM	<5% THD

AM Distortion: 6062A

AM Depth	100 kHz to 1 MHz	1 MHz to 1050 MHz	1050 MHz to 2100 MHz
0 to 30% AM	<3% THD	<1.5% THD	<3% THD
30 to 70% AM	<5% THD	<3% THD	<3% THD
70 to 99% AM	<7% THD	<5% THD	<5% THD

Incidental FM:
<.3 f_m at internal rates and <30% AM to 1050 MHz
<.6 f_m above 1050 MHz (6062A)

Rates

Internal Rates: 1400 Hz and 1 kHz (see Modulation Source for specifications)

External BW: 1(3 dB)

	6060B & 6061A	6062A
AC-coupled	.02 to 30 kHz	.02 to 50 kHz
DC-coupled	N/A	DC to 50 kHz

Frequency Modulation

Deviation Ranges: 100 to 999 Hz, 1 to 9.99 kHz, 10 to 99.9 kHz, 100 to 400 kHz (6062A only)

Maximum Deviation: The following table applies for modulating frequencies of 200 Hz and above

	Maximum Peak Deviation	
Output Frequency	6060B and 6061A	6062A
Below 245 MHz	100 kHz	200 kHz
245 to 512 MHz	100 kHz	100 kHz
512 to 1050 MHz	100 kHz	200 kHz
1050 to 2100 MHz	N/A	400 kHz

Maximum Deviation for Low Modulating Frequencies: At low audio frequencies, maximum FM deviation is modulation-index limited. Use the following formulas to compute maximum allowable deviation

	6060B and 6061A	6062A
Below 24 MHz	dev. = $2f_m(f_o+800)$	dev. = $2f_m(f_o+800)$
245 to 1050 MHz	dev. = $2f_mf_o$	
245 to 2100 MHz		dev. = $2f_mf_o$

f_o= RF frequency in MHz
f_m= modulation frequency in Hz
dev.= max peak deviation in Hz

Example: If f_o = 300 MHz and f_m = 50 Hz, the maximum allowable deviation is 30 kHz. i.e., (2)(50)(300) = 30,000 Hz or 30 kHz

FM Deviation Accuracy: ±7% for rates of 0.3 to 20 kHz for carrier frequency greater than 400 kHz, FM deviation >100 Hz

AF Bandwidth: .02 to 100 kHz (3 dB)

Distortion: Less than 1% THD for .3 to 20 kHz rates, FM deviation >100 Hz (effects of Residual FM excluded)

Incidental AM: Less than 1% AM at 1 kHz rate and less than 50 kHz deviation

Internal Rates: 400 Hz and 1 kHz (see Modulation Source for specifications)

External BW: (3 dB) 20 Hz to 100 kHz

Phase Modulation (6062A only)

Deviation Ranges: .01-.099 rad, .100-.999 rad, 1.00-9.99 rad, and 10.0-40.0 rad

Maximum Phase Deviation:

	Peak Deviation
Below 245 MHz	20 radians
245 to 512 MHz	10 radians
512 to 1050 MHz	20 radians
1050 to 2100 MHz	40 radians

Accuracy: ±7% for rates of 0.3 to 10 kHz and greater than .01 rad deviation

Distortion: Less than 1% THD at 1 kHz rate and >.01 rad deviation

Bandwidth: 20 Hz to 10 kHz (3 dB)

Incidental AM: 1Less than 1% AM at 1 kHz rate and less than 40 rad deviation

Pulse Modulation (6062A only)

ON/OFF Ratio: 80 dB minimum
Rise and Fall Times: 15 nanoseconds maximum
Level Error: For pulse width ≥50 nsec, power in pulse within ±0.5 dB of CW level
Duty Cycle: 0-100%
Rep Rate: DC-16 MHz
Internal Modulation: 400 Hz, 1000 Hz rates, 50% duty cycle
Pulse Modulator Input (External): Nominal 50Ω impedance with internal pull-up. Can be driven directly by TTL

Input Voltage	Modulator State*
<0.9 Volts	RF OFF
>1.1 Volts	RF ON
Open Circuit	RF ON

**EXT PULSE enabled*

Modulation Source

Internal: 400 Hz or 1 kHz, ±3% for 20-30°C; add ±0.1%/°C outside this range
External: 1 volt peak causes indicated modulation index. Internal and External modulation sources may be enabled simultaneously, and combine linearly
Input Impedance: 600 Ωs nominal (560 Ωs nominal when EXT AM and EXT FM enabled simultaneously)
External Modulation Annunciators: EXT HI/ EXT LO indicator when 1V peak, ±2% is applied at MOD IN connector .02 to 100 kHz BW

Memory

Type: Non-volatile. Data is stored 2 years (typical) with power off
Size: 50 complete front panel settings
Features: 1Store, recall, sequence

Option Specifications

Option -130: High Stability Crystal Oscillator
Option -132: Medium Stability Crystal Oscillator
See data under Reference Oscillator section.
Option -488: IEEE-488 Compatible Interface (standard on 6061A and 6062A). For field installation order -489K (Kit)
Interface: IEEE-488-1978
Functions Controlled: All front panel controls except line power switch
Data Output: Instrument status, stored memory contents, instrument settled, instrument ID, option complement, uncal/reject entry status, operating time
Indicators: Remote, Addressed, SRQ
Interface Functions: SH1, AH1, T5, TE0, L3, LE0, SR1, LR1, PP0, DC1, DT1, C0, E1
Option -651: Low Rate AC-coupled FM
Maximum Deviation: 9.99 kHz
Bandwidth (3 dB): 0.5 Hz to 100 kHz (typical)
Droop: 15% typical on 7 Hz squarewave
Maximum DC Input: ±10 mV
Note: See also 6060B/AK for enhanced low-rate FM capability.
Option -830: Rear Only RF output and modulation inputs. Type N RF output connector on rear panel

General Specifications

Operating Temperature: 0°C to 50°C
Storage Temperature: -40°C to 75°C
Humidity (operating): 0-95% up to 30°C, 0-75% 30°C to 40°C, 0-45% 40°C to 50°C
Altitude (operating): ≤10,000 ft
Power: 100, 120, 220, 240V ac ±10%, 47-63 Hz, (for 400 Hz consult the factory) <180 VA, (<15VA standby with opt -130
Weight: <16 kg (35 lb)
Size: 13.3 cm H x 43.2 cm W x 55.3 cm D (5.25 in x 17 in x 21.8 in)
EMI: Meets MIL-STD 461B RE02, CE03, FCC Part 15(j), Class B

Rear Panel Connectors and Controls

Standard:
10 MHz OUT: Connector to monitor internal 10 MHz reference
REF INT/EXT: Control to enable REF IN connector and disable internal reference
REF IN: Connector to input external reference (see Reference Oscillator)
Option:
MOD IN, RF OUT: Present only if -830 is installed
PULSE IN (6062A): Present only if -830 is installed
IEEE-488 Connector: Standard on 6061A and 6062A, optional on 6060B

Ordering Information

Models

January 1989 prices

6060B 1 GHz Signal Generator	$5225
6061A 1 GHz Signal Generator	5895
6062A 2 GHz Signal Generator	11,295

Options (for above Models)*

-130 High Stability Reference	1250
-132 Mid Stability Reference	400
-488 IEEE-488 Interface (6060B only)	395
-488K IEEE-488 Interface (6060B only)	415
-651 Low-rate AC-FM	395
-830 Rear Output and Modulation Input	125

**See chart page 244 for compatibility*

Accessories (Also see page 485)

Y6001 Rack Mount Kit, inc 24" slides	$295
Y9100 Attenuator, 50Ω, 6 dB, BNC	55
Y9101 Attenuator, 50Ω, 14 dB, BNC	55
Y9102 Attenuator, 50Ω, 20 dB, BNC	55
Y9103 50Ω Feed-through Termination, BNC	35
Y9111 3 ft (0.91m) 50Ω Cable, BNC to BNC	20
Y9112 6 ft (1.83m) 50Ω Cable, BNC to BNC	20
Y9301 Min-Loss Pad, 50Ω to 75Ω	75
Y9307 Adapter, N to BNC, 75Ω	25
Y9308 Adapter, N to BNC, 50Ω	20
Y9315 Coaxial Cable, N male to N male, 6 ft	75
Y9316 Cap, Non-shorting, BNC	10
Y9317 50Ω Termination, N	95
PM 21XX Modular GPIB Switching System	see page 380
PM 2122 50Ω coaxial switch	see page 382
PM 2240 TestTeam Software	see page 374

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-6060B Repair (w/calibration)	422
SC1-6060B Repair (cal w/in or out data)	497
SC1-6060B Repair. (cal w/in and out data)	572
SC2-6060B Cal (1 yr recommended)	369
SC2-6060B Cal (1 yr w/in or out data)	444
SC2-6060B Cal (1 yr w/in and out data)	519
SC1-6061A Repair (w/calibration)	430
SC1-6061A Repair (cal w/in or out data)	505
SC1-6061A Repair (cal w/in and out data)	580
SC2-6061A Cal (1 yr recommended)	396
SC2-6061A Cal (1 yr w/in or out data)	471
SC2-6061A Cal (1 yr w/in and out data)	546
SC1-6062A Repair (w/calibration)	443
SC1-6062A Repair (cal w/in or out data)	518
SC1-6062A Repair (cal w/in and out data)	593
SC2-6062A Cal (1 yr recommended)	432
SC2-6062A Cal (1 yr w/in or out data)	507
SC2-6062A Cal (1 yr w/in and out data)	582

6060A/AN

(NSN 6625-01-222-5007) **6060A/AN**

6060A/AN Signal Generator/Deviation Meter

- 10 kHz to 520 MHz
- -127 dBm to +13 dBm
- 500 kHz FM deviation
- Built-in FM deviation meter for transmitter alignment

The 6060A/AN combines the capabilities of the Fluke 6060B, with the ability to measure FM deviation in one stand-alone unit.

The signal generator portion of this advanced unit has frequency range from 10 kHz to 520 MHz, +13 dBm to -127 dBm output amplitude range and AM and FM modulation.

The maximum FM deviation is 500 kHz allowing the 6060A/AN to be used on many more applications than just voice communications.

The user-interactive front panel provides instant operator feedback and helps reduce entry errors. A convenient memory feature will save you time. Also included standard are GPIB/IEEE-488* programmability and Reverse Power Protection. Surrounding all these capabilities is excellent RF shielding. And it is easy to service.

The FM Deviation measurement capability included in the 6060A/AN furnishes an effective means to measure the peak deviation (plus or minus) of a frequency modulated RF signal. Simply connect the signal of interest at the front panel connector provided for this function, then select the function and range. The result is displayed at the front panel.

Specifications

Technical Specifications

Specifications apply 1 hour after turn-on within operating temperature range.

Frequency (8-1/2-Digit Display)

Range: 0.01 MHz to 520 MHz
Resolution: 10 Hz
Accuracy: Same as reference (see Reference)
Reference
Internal: Accuracy within 10 ppm of indicated frequency. Unit operates on an internal free-air 10 MHz crystal oscillator, aging <±0.5 ppm/month. <±5 ppm for 25°C, ±25°C. Frequency stability <±0.5 ppm/hour 1 hour after warm up. Internal reference signal (10 MHz TTL) available at rear connector
External: Accepts 10 MHz TTL signal

Amplitude (3-1/2-Digit Display)

Range (Indicated): +13 (+13 peak on AM) to -127 dBm
Resolution: 0.1 dB (<1% or 1 nV in volts)
Accuracy: ±2.5 dB
Source SWR: <1.3, below -10 dBm
Spectral Purity (CW Mode Only)
Spurious: <-35 dBc
Harmonics: <-30 dBc from 10 MHz to 520 MHz; <-26 dBc from 0.01 MHz to 10 MHz
Residual FM (peak in 0.05 kHz to 15 kHz band): <200 Hz
Residual AM (in 0.05 kHz to 15 kHz band): <-60 dBc

Amplitude Modulation (2-Digit Display)

Depth Range: 0% to 99%
Resolution: 1%
Accuracy: ±6% of setting for internal rates; RF peak amplitude of +13 dBm or less
Distortion: <5% THD at 50% AM for 1 kHz rate
Rates: 10 Hz to 20 kHz
External Input Level: Less than 10V peak-to-peak into 600 Ωs

Frequency Modulation (3-Digit Display)

Deviation Ranges: 1 kHz to 9.99 kHz, 10 kHz to 99.9 kHz, and 100 kHz to 500 kHz
Maximum Deviation: 500 kHz at rates above 50 Hz. 50 kHz between frequencies of 0.1 MHz and 5 MHz and rates above 50 Hz
Resolution: Three digits
Accuracy: ±5% for 1 kHz rate and >1 kHz deviation
Rates: 0.05 kHz to 100 kHz
External Input Level: Less than 10V peak-to-peak into 600 Ωs
Modulation Source
Internal: 0.4 kHz or 1 kHz, ±5%
External: ±5% max; 1V peak provides indicated modulation index. Nominal input impedance is 600 Ωs
Modes: Any combination of Internal AM, Internal FM, External AM, and External FM. Modulation may also be disabled. The nominal input impedance with both External AM and External FM enabled is 560 Ωs
Deviation Meter
Frequency Input: 30 MHz to 500 MHz
Input Signal Level: 15 mV to 5V rms
Input Impedance: 50 Ωs nominal
Measurement Ranges: Two ranges of 500 kHz and 50.0 kHz full scale
Polarity: Selectable ± peak
Modulation Rate: 100 Hz to 8 kHz
Accuracy: ±6% of full scale range from 100 Hz to 8 kHz

General Specifications

Temperature: 0°C to 50°C (32°F to 122°F), operating; -40°C to 70°C (-40°F to 158°F), non-operating
Humidity Range: 0-95% non-condensing, operating
Vibration: 5 Hz to 15 Hz at 0.06 in, 15 Hz to 25 Hz at 0.04 in, and 25 Hz to 55 Hz at 0.02 in. DA, non-operating
Shock: Bench handling per MIL-T-28800C Class 5, Style E, non-operating
Electromagnetic Compatibility: The radiated emissions induce <1 µV of the generator's output signal into a 1-inch diameter, two-turn loop, 1 inch from any surface as measured into a 50Ω receiver. Also complies with the following standards:
CE03 of MIL-STD-461B (power and interconnecting leads), 0.015 MHz to 50 MHz
RE02 of MIL-STD-461B (14 kHz to 10 GHz)
FCC Part 15 (j), Class A
CISPR 11

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Reverse Power Protection Level: Up to 50 watts from a 50Ω source, 0.01 MHz to 520 MHz. Will withstand up to 25V dc. Protection not provided when instrument is off

IEEE-488 Interface Functions (IEEE Std 488-1978): SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP0, DC1, DT1, C0, and E1

Size: 43 cm W x 13.3 cm H x 55.3 cm D (17 in x 5.25 x 21.8)

Power: 115V, 230V ac ±10%, 47 Hz to 400 Hz, <100 watts

Weight: <18.2 kg (40 lb)

Calibration Interval: After calibration, the equipment shall meet each performance requirement within the tolerance specified for a period of 9 months

Supplemental Characteristics

The following characteristics are provided to assist in the application of the instrument and to describe the typical performance that can be expected.

Frequency Switching Speed: <150 ms to be within 100 Hz of final frequency

Amplitude Switching Speed: <100 ms to be within 0.1 dB of final amplitude

Amplitude Range: Programmable to +19 dBm and -147.4 dBm, usable to +15 dBm. Fixed-Range, selected by Special Function, allows for more than 12 dB of vernier without switching the attenuator

AM Accuracy: ±(2% + 4% of setting) for internal rates, for depths 90% or less and peak amplitude of +13 dBm or less

AM Distortion: <1.5% THD to 30% AM, <30% to 70% AM, <5% to 90% AM at internal rates

Incidental FM: <0.3f_m for internal rates and 30% AM

FM Accuracy: ±7% for rates from 0.3 to 20 kHz >1 kHz deviation f_o >0.4 MHz

FM Distortion: <1% THD for rates of 0.3 kHz to 20 kHz, 1 kHz to 99.9 kHz deviation for f_o >5 MHz

Incidental AM: <1% AM at 1 kHz rate, for the maximum deviation or 50 kHz, whichever is less

Residual FM (rms in 0.3 kHz to 3 kHz Band): <15 Hz from 245 to 520 MHz; <30 Hz elsewhere

Residual FM (rms in 0.05 kHz to 15 kHz Band): <30 Hz from 245 to 520 MHz; <60 Hz elsewhere

Noise (at 20 kHz offset): <-113 dBc/Hz (except <-107 dBc/Hz below 245 MHz)

Spurious: <-60 dBc for offsets greater than 10 kHz. Fixed frequency spurs are <-60 dBc or <-140 dBm, whichever is larger

External Modulation: Annunciators indicate when a 1V peak signal is applied, ±2%, over a 0.02 kHz to 100 kHz band

Deviation Meter Accuracy: ±5% of reading ±1 count for rates between 100 Hz and 10 kHz

IEEE-488 Interface: All controls except the power switch and the internal/external reference switch are remotely programmable via IEEE Std 488-1978

Ordering Information

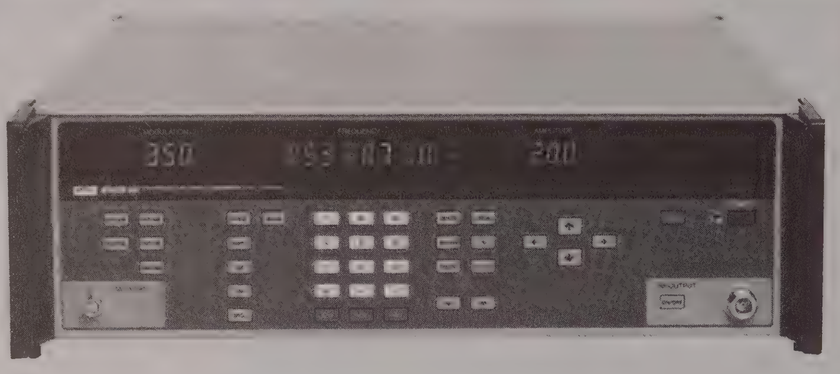
Model

	January 1989 prices
6060A/AN Synthesized Signal Generator	$7500

Accessories (Also see page 485)

Y6001 Rack Mount Kit, includes 24" slides	295
Y9100 Attenuator, 50Ω, 6 dB, BNC	55
Y9101 Attenuator, 50Ω, 14 dB, BNC	55
Y9102 Attenuator, 50Ω, 20 dB, BNC	55
Y9103 50Ω Feed-through Termination, BNC	35
Y9111 3 ft (0.91m) 50Ω Cable, BNC	20
Y9112 6 ft (1.83m) 50Ω Cable, BNC	20
Y9301 Min-Loss Pad, 50Ω to 75Ω	75
Y9307 Adapter, N to BNC, 75Ω	25
Y9308 Adapter, N to BNC, 50Ω	20
Y9315 Coaxial Cable, N Male to N Male, 6 ft	75
Y9316 Cap, Non-shorting, BNC	10
Y9317 50Ω Termination, N	95
PM 21XX Modular GPIB Switching System	see page 380
PM 2122 50 Ω coaxial switch	see page 382
PM 2240 TestTeam software	see page 374

6060B/AK



6060B/AK

6060B/AK: Pager & Communications Testing Signal Generator

- 10 kHz to 1050 MHz
- ±1 dB Absolute Level Accuracy from +13 dBm to -127 dBm
- Residual FM <8 Hz at 500 MHz
- RFI leakage <0.5 microvolts
- Compatible with digital paging codes
- 50 location non-volatile memory

The 6060B/AK is a special-purpose version of the 6060B, that has improved noise characteristics and enhanced Frequency Modulation capabilities. It is designed for radio communica tions testing; in particular, applications in which digital signaling using FSK is used in addition to voice.

This enhanced modulation characteristic of the 6060B/AK enables it to work well with digital squelch and digital paging systems. It will accommodate very low rate paging codes including Motorola, Golay-Sequential Code (GSC) NEC, NTT and British-Post-Office-Code-Standardization-Advisory-Group (POCSAG).

Specifications

Technical Specifications

Frequency

Frequency Range: 10 kHz to 1050 MHz. Output frequency is displayed on an 8-digit display
Frequency Resolution: 10 Hz
Switching Speed: <100 ms typical (within ±100 Hz of selected value)
Frequency Accuracy: Referenced to internal free-air 10 MHz crystal oscillator, <±0.5 ppm/month; <±5 ppm for 25°C ±25°C (see also Options -130 and -132). Internal 10 MHz reference sinewave output signal available at rear panel

Reference Output

Frequency: 10 MHz, sinewave
Level: 0 dBm min into 50 ohms
Source Impedance: 50 ohms nominal

External Reference

Input Frequency: 1, 2, 2.5, 5, 10 MHz
Input Level: .3 to 4V pk-pk, sinewave or square-wave
Input Impedance: 50 ohms nominal

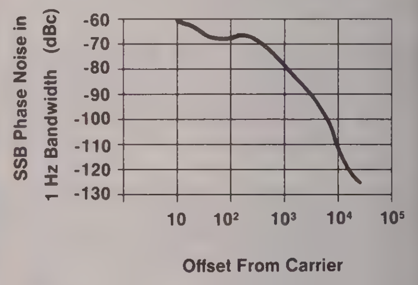
Amplitude

Amplitude Range: -127 to +13 dBm (+13 dBm peak on AM), with overrange to -147 and +19 dBm, displayed on a 3-digit display. Fixed- range output, selected by special function, allows more than 12 dB of vernier without attenuator switching
Amplitude Resolution: 0.1 dB. Annunciators for dB, dBm, V, mV, and µV provided on the display
Switching Speed: <100 msec typical (within 0.1 dB of selected value)
Amplitude Accuracy: ±1.0 dB 0.4-1050 MHz (20°C ±5°C)
Output Impedance: 50 ohms, nominal
Output SWR: <2.0; <1.5 below 1 dBm 2400 kHz
RF Leakage: <0.5 µV at carrier frequency

Spectral Purity

Spurious: <-60 dBc for offsets greater than 10 kHz, (-55 dBc <100 kHz)
Harmonics: <-30 dBc (-26 dBc <100 kHz)
Residual FM (0.3 to 3 kHz band): <8 Hz rms from 245 to 512 MHz; <16 Hz rms elsewhere
Residual FM (0.05 to 15 kHz band): <12 Hz rms from 245 to 512 MHz; <24 Hz rms elsewhere
Residual AM: 0.1% rms (-60 dBc) in 0.05 to 15 kHz band (-55 dBc <100 kHz)

Typical SSB Phase Noise @ 500 MHz (with internal reference)



Amplitude Modulation

Depth Range: 0 to 99%, with 1% resolution (displayed on 2-digit front panel display)
Accuracy: ±(2% + 4% of setting), for 0.1 to 3 kHz rates, depths to 90%, and peak amplitude of <+13 dBm
Distortion: <1.5% THD, to 30% AM; <3% THD, to 70% AM; <5% THD, to 90% AM for <950 MHz and levels <+8.0 dBm
Bandwidth: 20 Hz to 30 kHz, 3 dB
Incidental FM: <0.3 f_m for internal rates and <30% AM

Frequency Modulation

Deviation Ranges: 100 to 999 Hz; 1 to 9.99 kHz; and 10 to 99.9 kHz (displayed on 2-digit front panel display)
Maximum Deviation: Lesser of 99.9 kHz and $2f_m f_0$ above 245 MHz, or $2f_m(f_0 +800)$ below 245 MHz, where f_0 is in MHz and f_m in kHz $(f_0-100)/3$ kHz below 0.4 MHz [f_0 in kHz]
Accuracy: ±7% for rates of 0.3 to 20 kHz (0.3 to 1 kHz for f_0 <0.4 MHz)
Distortion: <1% THD for rates of 0.3 to 20 kHz (0.3 to 1 kHz for f_0 <0.4 MHz) and <100 Hz deviation
Bandwidth: (3 dB) 0.5 Hz-100 kHz for <400 kHz carrier frequency
Droop: 15% on a 10 Hz squarewave
Incidental AM: <1% AM at 1 kHz rate and deviation of 50 kHz

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Modulation Source

Internal: 400 Hz and 1 kHz, ±3% for 20°C to 30°C (add ±0.1%/°C outside this range). Selectable from the front panel
External: 1 volt peak input (MOD IN BNC) provides indicated modulation index. Input impedance = 600 ohms, nominal
Modes: INTAM; INTFM; EXTAM; EXTFM; IN TAM and FM: EXTAM and FM; and INT(AM and/or FM) and EXT(AM and/or FM), in all nine combinations. Input impedance = 560 ohms, nominal, when EXTAM and FM are both enabled

Sub-Harmonic External Reference
Input: 1, 2, 2.5, 5, and 10 MHz, 0.3 to 4V p-p sine or squarewave into 50 ohms (nominal)
Input Connector: BNC on rear panel

Non-Volatile Memory

Description: Up to 50 front panel control set tings can be retained for 2 years. Battery power is used when the 6060B/AK is in standby or the power cord is not attached.

Reverse Power Protection

Protection Level: Up to 50 watts from a 50 ohm source or 50V dc, from 10 kHz to 1050 MHz (dc blocking capacitor at output)
Trip/Reset: Flashing RFOFF annunciator indicates a tripped condition. Pushing RFON/OFF button on front panel will reset the output. Protection is not provided when the instrument is in off.

Option Specifications

All options are factory installable only.

High Stability Reference Option (-130)
Aging Rate: <±5 x 10^{-10}/day, after 21 days
Temperature Stability: <±2 x 10^{-10}/°C. Oven remains powered during standby
Installation: Mounts inside rear panel; includes auxiliary power supply

Mid Stability Reference Option (-132)
Aging Rate: ±5 x 10^{-7}/mo, after 21 days
Temperature Stability: ±1 x 10^{-7} (0° to 50°C)

IEEE-488 Compatible Interface Option (-488)
Functions: All front panel controls except the power switch are programmable via the IEEE-488 interface. Instrument status is also available remotely. The 6060B/AK supports the following IEEE-488 functions SH1, AH1, T5, L3, SR1, RL1, PP0, DC1, DT1, C0, E2

Rear RF Output and MOD Input Option (-830)
Description: Moves front panel RF OUTPUT and MOD INPUT connectors to the rear panel

General Specifications

Temperature: 0 to 50°C, operating; -40 to 75°C, non-operating
Humidity: 1 to 95% RH to 30°C; 0 to 75% RH to 50°C, operating
Altitude: 3,050m (10,000 feet), operating
Shock and Vibration: Per MIL-T-28800C, except spectral purity may be degraded; 5 to 15 Hz at 0.06 in; 15 to 25 Hz at 0.04 in; and 25 to 55 Hz at 0.02 in
EMI: Radiated emissions induce <0.5 µV at output frequency into a 1 inch diameter, 2 turn loop, 1 inch from any surface as measured into a 50 ohm receiver. Also compliance with the following standards:
CE03, MIL STD 461B Power and interconnecting leads, 0.015 to 50 MHz;
RE02, MIL STD 461B 14 kHz to 10 GHz, method RE02-1 and RE02-2 of MIL STD 462; FCC Part 15 (j), Class A;
Power: 100V, 120V, 200V, 240V ac ±10%, 47 to 63 Hz, <180 VA; <15 VA standby with Option -130
Size: 55.3 cm L x 43 cm W x 13.3 cm H (21.8 in L x 17 in W x 5 in H)
Weight: <15.9 kg (35 lb)

Ordering Information

Model

January 1989 prices

6060B/AK Signal Generator	$5750

Options** (for 6060B/AK)

-130* High Stability Reference	1250
-132* Mid Stability Reference	400
-488 IEEE Interface	395
-488K IEEE-488 Interface	415
-830 Rear Output and Modulation Input	125

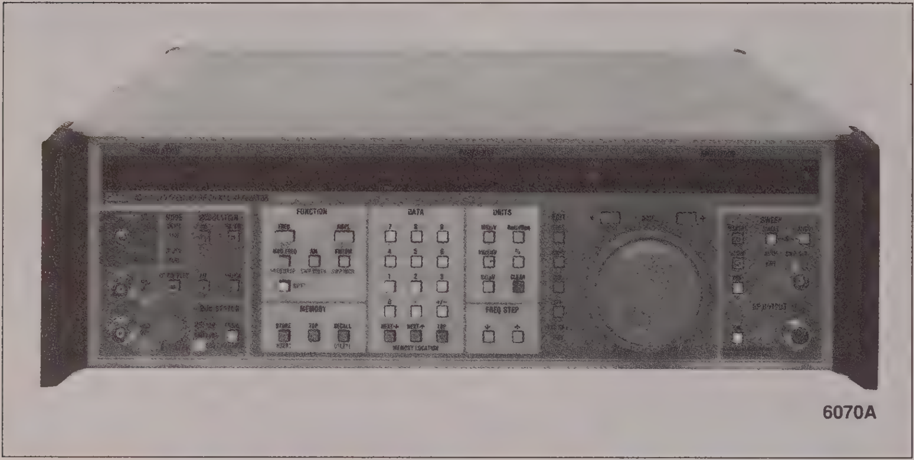
**See specifications on page 249*
***See option compatibility chart on page 244*

Accessories (Also see page 485)

Y6001 Rack Mount Kit, inc. 24" slides	295
Y9100 Attenuator, 50Ω, 6 dB, BNC	55
Y9101 Attenuator, 50Ω, 14 dB, BNC	55
Y9102 Attenuator, 50Ω, 20 dB, BNC	55
Y9103 50Ω Feedthru Termination, BNC	35
Y9111 3 ft (0.91m) 50Ω Cable, BNC	20
Y9112 6 ft (1.83m) 50Ω Cable, BNC	20
Y9301 Min-Loss Pad, 50Ω to 75Ω	75
Y9307 Adapter, N to BNC, 75Ω	25
Y9308 Adapter, N to BNC, 50Ω	20
Y9315 Coaxial Cable, N male to N male, 6 ft	75
Y9316 Cap, Non-shorting, BNC	10
Y9317 50Ω Termination, N	95

6070A & 6071A

GPIB
IEEE-488


6070A

6070A & 6071A, to 520 MHz or 1040 MHz
Non-harmonic spurious outputs: -90 dBc to -100 dBc to 520 MHz
Precision digital sweep
Front panel memory
AM, FM, øM modulation
Responsive spin knob tuning
Low output VSWR and optional reverse-power protection
Relative amplitude and frequency mode

Design innovations in the 6070A and 6071A combine the precision resolution and settability of a synthesizer with the low-noise performance of the best open-loop signal generators on the market. And these two state-of-the-art instruments were developed to be competitively priced as well as cost effective in other ways.

The 6070A and 6071A are programmable and directly compatible with GPIB/IEEE-488*-1978. With them, you may make sophisticated tests and measurements rapidly and with great precision. On VHF and UHF receivers you can measure selectivity, sensitivity, intermodulation distortion, AM rejection, AGC response, audio hum, noise and distortion, and SINAD ratio. Or you can align a discriminator or check IF response using the digital sweep feature.

Spectral purity is excellent. Spurious outputs, those not related harmonically to either the carrier frequency or the power line frequency, are on the order of -90 dBc to -100 dBc to 520 MHz and -84 dBc above 520 MHz. The typical broadband noise floor is a comfortable -150 dBc per Hz, and the single sideband phase- noise is typically -138 dBc per Hz at 20 kHz offset from a 500 MHz carrier. These specifications, by any standard, reflect a truly excellent level of spectral purity.

AM, FM, øM Modulation

Amplitude modulation depth can be set from 0% to 99.9% in 0.1% steps. External dc coupling is provided for leveling, extending bandwidths down to dc, or providing analog control of out put amplitude.

Frequency or phase modulation can be set with deviations up to 1 MHz or 100 radians respectively, depending on the rf frequency. Exceptionally wide deviation is made possible by a high deviation mode that is automatically activated when required. External, dc-coupled FM is available for phase locking the instrument to another source. That extends the maximum deviation at low rates, and provides for analog sweeping with an external signal.

Simultaneous AM+FM or AM+øM is available internally or from internal-external combinations. The internal modulation oscillator covers a wide range of frequencies. It can be continually varied from 20 Hz to 200 kHz, with an overrange capability extending it from 1 Hz to 255 kHz in steps of approximately 0.1%.

The modulation oscillator output is available at a front panel connector. This provides you with an audio source separate from the rf out put. Typical total harmonic distortion is 0.05%.

IEEE-488 Interface

No option is required to make the 6070A or 6071A compatible with IEEE Std 488-1978; the capability is built in. And all of the functions that may be controlled from the front panel manually are also controllable remotely in an IEEE-488 system, except for turning power on and off and controlling the modulation signal output level. Status indicators are: Remote, Addressed, and SRQ. Interface functions are: SH1, AH1, T6, L3, SR1, RL1, DC1, DT1, C0, E2.

Precision Digital Sweep

Versatile sweep modes let you characterize devices such as wideband amplifiers, narrowband crystal filters, and other rf components. Repetitive, single, or manual modes are available with either symmetrical or asymetrical sweeps. Five sweep step intervals between 20 ms and 500 ms may be selected. A coincidental 0 to 10V staircase sweep signal is available at an output connector to drive X-Y recorders or oscilloscopes. Another rear-panel output signal provides Z-axis blanking for oscilloscopes or a penlift signal for X-Y recorders.

Front Panel Program Memory

Up to nine different combinations of front-panel control settings may be stored and later recalled. Up to 50 combinations may be stored in a non-volatile memory using Option -570. This feature reduces errors and saves time in making common measurements.

Responsive Spin-Knob Tuning

In addition to the simple keystroke operation and layout of the front-panel controls, a high-inertia, magnetically detented, optically coupled knob provides analog convenience when continuous adjustments are required. It may be used to select frequency, amplitude, or modulation. Each complete turn gives you 25 increments or decrements, depending on direction of rotation.

Low Output VSWR & Optional Reverse-Power Protection

The rf output impedance of the 6070A and 6071A is 50 ohms with a low source VSWR to minimize the effects of signals reflected from loads having a high VSWR. Option -870 protects the output circuits from being damaged when connected to a transceiver that accidentally transmits power.

Relative Units

A relative-amplitude mode makes it easy to compensate for cable loss, attenuation in the rf output, make linearity tests on detectors and amplifiers, and measure AGC characteristics. Output levels are selectable in 0.1 dB steps, all the way from -140 dBm to +19 dBm for frequencies up to 520 MHz (+13 dBm above 520 MHz). Flatness is typically ±0.2 dB from 200 kHz to 520 MHz, ±0.3 dB to 1040 MHz.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

6070A & 6071A

Besides offering 1 Hz resolution up to 520 MHz (2 Hz above 520 MHz), a relative-frequency mode allows you to display specific frequencies above and below a selected center frequency. It makes testing the frequency response of filters and IF strips easy.

Specifications

Technical Specifications

Specifications for frequencies above 520 MHz apply to 6071A only.

Frequency

6070A Ranges: 0.2 to 519.999 999 MHz
6071A Ranges: 0.2 to 1039.999 998 MHz
6070A Resolution: 1 Hz
6071A Resolution: 1 Hz (<520 MHz), 2 Hz (≥520 MHz)
Accuracy & Stability: Same as Reference Oscillator

Reference Oscillator

Internal Standard: 10 MHz quartz oscillator. Aging rate 1±0.5 ppm/month. Temperature effects: <±5 ppm 0 to 50°C instrument ambient (relative to 25°C)
Option -130: 10 MHz ovenized oscillator. (See options)
External: 1, 2, 2.5, 5, 10 MHz input. Level required is 0.3 to 4.0V pp sinewave or square wave. Input impedance is 50 ohms. External reference is automatically switched in when connected
Reference Output: 10 MHz TTL level

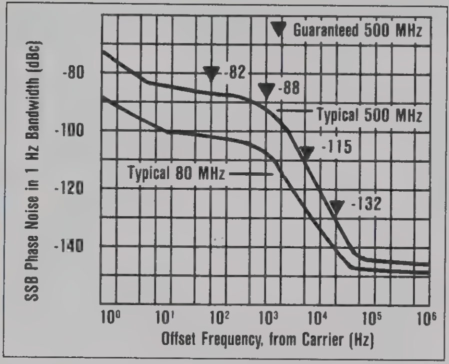
Spectral Purity

All specifications are with High Deviation mode off

SSB Phase Noise

SSB Phase Noise for CW and AM Modes (dBc/Hz)

Carrier Frequency Range	Offset Frequency, from Carrier				
	100 Hz	1 kHz	5 kHz	20 kHz	<3 MHz
0.2 to 62.5 MHz	-75	-85	-106	-123	-129
62.5 to 125 MHz	-94	-100	-125	-140	-144
125 to 250 MHz	-88	-94	-121	-138	-144
250 to 520 MHz	-82	-88	-115	-132	-144
520 to 1040 MHz	-76	-82	-109	-126	-138



Residual FM for CW and FM Modes (Hz rms)

Carrier Range	0.3 to 3 kHz bw	0.5* to 15 kHz bw
0.2 to 62.5 MHz	3.5	5.0
62.5 to 125 MHz	0.3	0.75
125 to 250 MHz	0.85	1.3
250 to 520 MHz	1.7	2.5
520 to 1040 MHz	3.4	5.0

**Typically the same for 0.02 to 15 kHz bandwidth.*

Residual AM: ≤0.02% rms (-74 dBc) in a 0.05 to 15 kHz post-detection bandwidth, referred to 100% sinewave modulation. Typically the same in a 0.02 to 15 kHz post-detection bandwidth

Spurious Signals (dBc)

Relationship to Output Carrier Frequency (f_0)	Carrier Frequency Range				
	200 kHz to 62.5 MHz	62.5 MHz to 125 MHz	125 MHz to 250 MHz	250 MHz to 520 MHz	520 MHz to 1040 MHz
Non-Harmonic <10 kHz offset 550 Hz to 10 kHz offset	-90 -70	-100 -82	-96 -76	-90 -70	-84 -64
Power Line, Display, Mechanical <550 Hz offset	-56	-68	-62	-56	-50
Sub-Harmonic $f_0/2$, $3f_0/2$, $5f_0/2$ offset	N/A	N/A	N/A	N/A	-35
Harmonic (6070A) f_0, $2f_0$, $3f_0$ offset, >+13 dBm ≤+13 dBm	-30 -35	-30 -35	-30 -35	-25 -35	N/A N/A
Harmonic (6071A) f_0, $2f_0$, $3f_0$ offset, >+13 dBm ≤+13 dBm	-30 -35	-30 -35	-25 -35	-20 -35	N/A -25

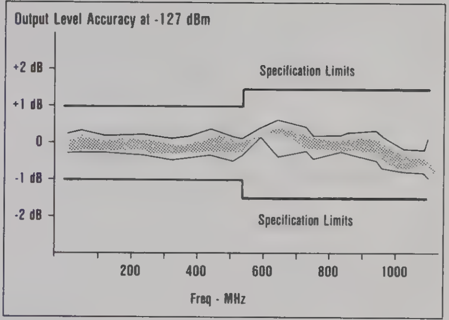
Output

Voltage Level Range: -140 dBm to +19 dBm for frequencies up to 520 MHz. Above 520 MHz (6071A), -140 dBm to +13 dBm
Resolution: 0.1 dB or 1% of voltage

Accuracy (dB)

Output	0.2 to 520 MHz	520 to 1040 MHz
+19 to +13 dBm +13 to -127 dBm	±1.0	N/A ±1.5

20°C ±5°C



Typical amplitude data measured at -127 dBm. 75% of the units measured within the shaded area. The outer lines represent worst-case measurements.

Output Impedance: 50 ohms, nominal

SWR

Output Level	0.2 to 520 MHz	520 to 1040 MHz
≥+7 dBm	2.0	2.5
<+7 dBm	1.5	2.0

Amplitude Modulation

AM Depth: 0 to 99.9% in 0.1% steps
AM Accuracy: (Internal or External)

Carrier Range	Modulation Frequency	AM Depth	Depth Accuracy
0.2 to 5 MHz	≤1 kHz	<90%	+5%, -8%
5 to 520 MHz	≤3 kHz	<90%	±5%
520 to 1040 MHz	≤3 kHz	≤70%	±5%

AM Distortion

Carrier Range	Modulation Frequency	AM Depth		
		0 to 30%	30 to 70%	70 to 90%
0.2 to 5 MHz	≤1 kHz	<2%	<5%	<7%
5 to 520 MHz	≤3 kHz	<1.5%	<3%	<3%
520 to 1040 MHz	≤3 kHz	<2%	<3%	<5%

AM Signal Bandwidth (-3 dB)

Current Range	AM Depth	Internal or External AC Coupled	External DC Coupled
0.2 to 5 MHz	≤70%	20Hz-8 kHz	DC-8 kHz
5 to 520 MHz	≤90%	20 Hz-50 Hz	DC-50 kHz
520 to 1040 MHz	≤70%	20 Hz-50 kHz	DC-50 kHz

Incidental FM (for 30% AM): 0.3 x modulation frequency for <520 MHz; 0.6 x modulation frequency for >520 MHz

6070A & 6071A

Frequency Modulation

Maximum Peak Frequency Deviation (kHz)

Frequency Range	ACFM the lesser of	DCFM the lesser of
0.2 to 62.5 MHz	999 or f_m x (520-f_o)	499
62.5 to 125 MHz	199 or f_m x f_o	f_o or 99.9
125 to 250 MHz	499 or f_m x f_o	f_o or 199
250 to 520 MHz	999 or f_m x f_o	f_o or 499
520 to 1040 MHz	999 or f_m x f_o	f_o or 999

f_o + Output frequency in megahertz
f_m + Modulation frequency in kilohertz

FM Deviation Resolution: 100 Hz for <100 kHz deviation; 1 kHz for 2100 kHz deviation
FM Deviation Accuracy: (Internal or external) ±10% at 400 Hz or 1 kHz modulation rate; ±13% at 0.3 to 50 kHz modulation rate (including flat ness)

FM Total Harmonic Distortion

Output Frequency Range	DCFM Mode Off and High Deviation: Off 0.5%+	DCFM Mode Off and High Deviation: On	DCFM Mode On 0.5%+
0.2 to 62.5 MHz	0.75% per 100 kHz dev	1.5 %	1.2% per 100 kHz dev
62.5 to 125 MHz	3.0% per 100 kHz dev		(600 ÷ f_o) % per 100 dev
125 to 250 MHz	1.5% per 100 kHz dev		
250 to 520 MHz	0.75% per 100 kHz dev		
520 to 1040 MHz	0.375% per 100 kHz dev		

f_o = Output frequency in megahertz

FM Signal Bandwidth (-3 dB): 20 Hz to 250 kHz internal or ac coupled external. Dc to 250 kHz dc coupled external
Center Frequency Accuracy (DCFM Off): Same as reference oscillator

Center Frequency Accuracy (DCFM On)*

Output Frequency Range	Initial Accuracy	Typical Stability
0.2 to 62.5 MHz	±1 kHz	50 Hz/min
62.5 to 125 MHz	±250 Hz	12.5 Hz/min
125 to 250 MHz	±500 Hz	25 Hz/min
250 to 520 MHz	±1 kHz	50 Hz/min
520 to 1040 MHz	±2 kHz	100 Hz/min

**Auto-CAL upon initialization*

Incidential AM: ≤0.5% (-52 dBc) for deviations up to 50 kHz at 1 kHz rate (single sideband) component referred to sinewave modulation

Phase Modulation

Deviation and Distortion

Output Frequency Range	Max Peak Deviation Radians	Total Harmonic Distortion Per Radian of Deviation With High Deviation Mode: Off	Total Harmonic Distortion Per Radian of Deviation With High Deviation Mode: On
0.2-62.5 MHz	99.9	0.5+(0.75x10^{-5}xf_m)%	1.5 %
62.5-125 MHz	19.9	0.5+(3.0x10^{-5}xf_m)%	
125-250 MHz	49.9	0.5+(1.5x10^{-5}xf_m)%	
250-520 MHz	99.9	0.5+(0.75x10^{-5}xf_m)%	
520-1040 MHz	99.9	0.5+(0.375x10^{-6}xf_m)%	

f_m = Modulation frequency in hertz

øM Resolution: 0.01 radian for <10 radians, 0.1 radian for 210 radians
øM Deviation Accuracy: (Internal or external) ±10% at 400 Hz or 1 kHz modulation rate; ±13% at 0.3 to 3 kHz modulation rate (including flatness)
øM Signal Bandwidth (-3 dB): 0.02 to 12 kHz internal or ac coupled external. Dc to 12 kHz external dc coupled
Incidental AM: ≤0.5% (-52 dBc) for devations up to 50 radians at a 1 kHz rate (single sideband component referred to sinewave modulation)

Modulation Signal Source

Modes: AM, FM, øM, AM + FM, AM +øM
Range: 0.02 kHz to 200 kHz
Frequency Accuracy: ±3% for 20°C to 30°C ambient temperature range. Add 0.1% per degree C outside that range
Total Harmonic Distortion: <0.15% from 0.2 kHz to 100 kHz; <0.2% below 0.2 kHz and above 100 kHz
Output Level: 0V to 2V peak to peak into 600Ω Output Impedance: 600Ω, nominal via front panel BNC connector

External Modulation Input

Level: 1V peak for specified AM, FM, or øM accuracy
Impedance: 600Ω, nominal
Coupling: AC or DC

Switching Time

Frequency: <85 ms from last controller command (<35 ms for most small changes) until frequency has settled to within 100 Hz of final value. Applies to frequency changes only
Level: <50 ms from last controller command. Applies to level changes only

Frequency Sweep

Sweep Modes: Auto, Single, Manual
Sweep Functions: Symmetrical sweep, asymmetrical sweep, sweep speed
Data Entry: Sweep width, sweep increment
Sweep Speed: Approximately 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, per increment
Sweep Output: 0 to +10V, up to 1000-point stepped ramp. Available at front panel BNC connector
Penlift/Z Axis Blanking: TTL output level at rear panel BNC connector. High during sweep retrace and when sweep is off

Memory

Memory Functions: Store, recall, insert above, delete, top
Locations: 9 standard, volatile; Option-570 50 non-volatile. Front panel set-ups can be stored in each location and later recalled

Remote Programming

Interface: IEEE-488
Functions Controlled: All front-panel controls except line power switch and modulation out put amplitude (MOD OUT)
Status Indicators: Remote, Addressed, SRQ.
Interface Functions: SH1, AH1, T6, L3, SR1, RL1, DC1, DT1, C0, E2

Option Specifications

10 MHz Ovenized Oscillator (-130)

Aging rate <±5 x 10^{-10} per day after a 21-day warmup. Temperature effects: <±2 x 10^{-10}/°C
Non-Volatile Memory (-570)
50 locations; operational features same as standard features. Data is stored with built in battery when power is off

Rear RF Output (-830)

Type N rf output connector available on rear panel

Auxiliary RF Output (-831)

Greater than -18 dBm, available at rear panel BNC. Impedance, 50 ohms

Reverse Power Protection (-870)

Up to 50 watts from a 50 ohm source over 0.2 to 1040 MHz. Will withstand up to 50V dc

Pulse Modulation (-950)

Adds pulse modulation to 6070A only. Fast 25 rise/fall times with on/off ratio of 40 to 60 dB depending of carrier frequency

General Specifications

EMI: Meets MIL-STD 461A RE02 and CE03, and MIL-I-6181D Sections 4.3.1 and 4.3.2 for both narrowband and broadband tests. RF leakage: less than 3 µV is induced into a two-turn, 1 inch diameter loop 1 inch away from any surface and measured into a 50Ω receiver

Temperature: 0°C to 50°C, operating; -40°C to +75°C, non-operating

Relative Humidity: ≤95% to 25°C; ≤75% to 50°C

Altitude: 110,000 feet

Power: 100, 120, 200, 240V ac ±10% 47 to 63 Hz; 125 watts typical. For 400 Hz operation consult your Fluke representative

Size: 13.3 cm H x 43.2 cm W x 54.6 cm D from front panel to rear handle (5.25 in H x 17.0 in W x 21.5 in D)

Weight: 27.7 kg (61 lb)

Safety: CSA 556B certified

Included: Operator's manual, service manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

January 1989 prices

6070A Synthesized Sig Gen (0.2-520 MHz)	$18,900
6071A Synthesized Sig Gen (0.2-1040 MHz)	19,900

Options (for 6070A & 6071A)

-130 Ovenized Reference Oscillator	1200
-570 Non-Volatile Memory	550
-830 Rear RF Output	125
-831 Auxiliary RF Output	175
-870 Reverse Power Protection	280
-950 Pulse Modulation (6070A only)	4925

Accessories (Also see page 485)

Y6001 Rack Mount Kit inc 24" slides	295
Y9100 Attenuator, 55Ω, 6 dB, BNC	55
Y9101 Attenuator, 50Ω, 14 dB, BNC	55
Y9102 Attenuator, 50Ω, 20 dB, BNC	55
Y9103 50Ω Feedthru Termination, BNC	35
Y9111 3 ft (0.91m) 50Ω Cable, BNC to BNC	20
Y9112 6 ft (1.83m) 50Ω Cable, BNC to BNC	20
Y9308 Adapter, N to BNC, 50Ω	20
Y9315 Coaxial Cable, N male to N male left	75
Y9316 Cap, Non-shorting, BNC	10
Y9317 50Ω Termination, N	95
PM 21XX Modular GPIB Switching System	see page 380
PM 2122 50 Ω coaxial switch	see page 382
PM 2240 TestTeam Software	see page 374

Service & Support

Warranty

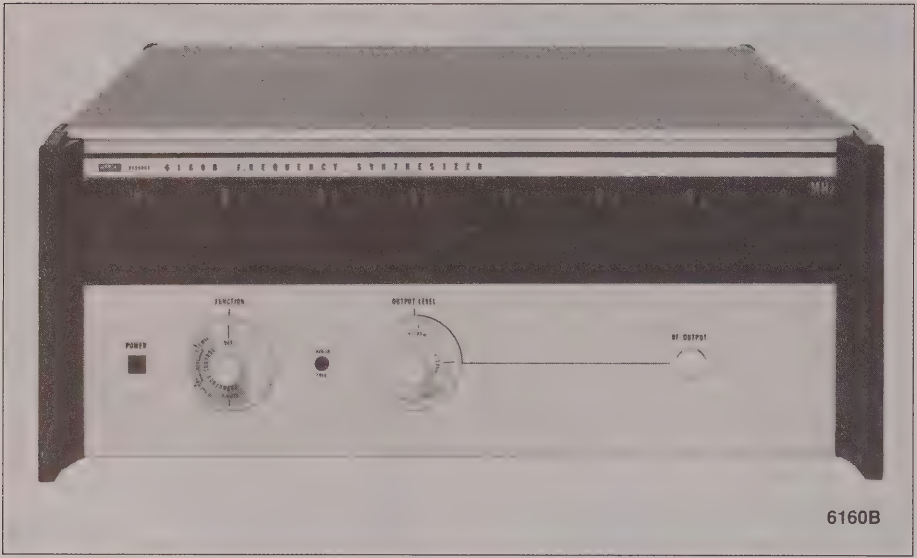
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-6070A Repair (w/calibration)	$ 598
SC1-6070A Repair (cal w/in or out data)	673
SC1-6070A Repair. (cal w/in and out data)	748
SC2-6070A Cal (1 per yr recommended)	495
SC2-6070A Cal (1 per yr w/in or out data)	570
SC2-6070A Cal (1 per yr w/in and out data)	645
SC1-6071A Repair (w/calibration)	667
SC1-6071A Repair (cal w/in or out data)	742
SC1-6071A Repair (cal w/in and out data)	817
SC2-6071A Cal (1 per yr recommended)	495
SC2-6071A Cal (1 per yr w/in or out data)	570
SC2-6071A Cal (1 per yr w/in and out data)	645

6160B

GPIB
IEEE-488



6160B

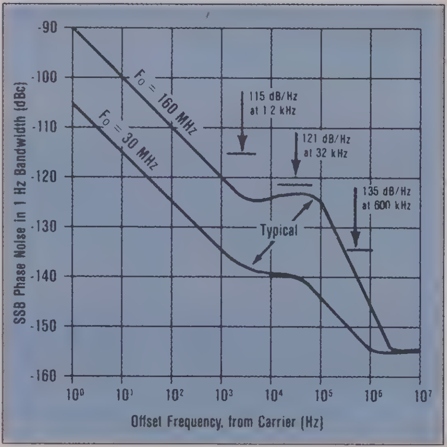
6160B Frequency Synthesizer

- High spectral purity: residual phase noise typically less than -74 dB
- Resolution: 0.1 Hz below 12 MHz; 1 Hz above
- Level flatness: ±1 dB into 50 ohms
- Switching speed: 800 µs
- Built-in BCD programming
- Optional GPIB/IEEE-488

The Fluke 6160B Frequency Synthesizer is the industry's most popular VHF synthesizer because of its high spectral purity. It produces frequencies from 1 MHz to 160 MHz in two ranges: 1 MHz to 12 MHz and 10 MHz to 160 MHz. Frequency resolution is 0.1 Hz on the 12 MHz range and 1.0 Hz on the 160 MHz range.

A unique feature of the 6160B is that the highest internally-generated frequency is that of the output VCO, i.e., 80 to 160 MHz. This makes servicing easier, and eliminates UHF EMC problems. Since the output VCO operates from 80 to 160 MHz, frequency division is employed for coverage of lower frequencies. This results in improved spurious specifications for frequencies lower than 80 MHz. Phase noise is similarly reduced for lower bands.

Built-in remote programming is DTL/TTL, BCD, positive true logic or by contact closures. Programming of frequency is via 34 parallel lines, and a remote flag and power flag are provided. Switching is fast, output level is electrically adjustable. Compatibility with GPIB/IEEE-488*-1978 is achieved using the Fluke 1120A Translator and 6XXXA-529 Interface.



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*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

Specifications

Technical Specifications

Parameter	
FREQUENCY	
High Band Range **Minimum Step**	10 MHz to 160 MHz 1 Hz
Low Band Range **Minimum Step**	1 MHz to 12 MHz 0.1 Hz
Local Control **Remote Control**	Front panel rotary switches BCD per decade, TTL, DTL positive true logic or contact closures. Logic "0" = 0 to 0.9V dc. Logic "1" = 2V to +5V dc or open circuit.
Spectral Purity* Non-Harmonic, Spurious	**MHz** / **dBc** 1 to 20 / -100 20 to 40 / -95 40 to 80 / -89 80 to 160 / -83
Harmonic, Spurious	<-25 dBc, typically <-30 dBc
Amplitude Noise**	<-94 dBc (typical)
Absolute Phase Noise**	<-62 dBc (typical)
Residual Phase Noise**	<-74 dBc (typical)
Phase Noise Spectral Density 1 Hz Bandwidth	**SSB Phase Noise** / **Offset from Carrier** 1.2 kHz / <-115 dBc 32 kHz / <-121 dBc 600 kHz / <-135 dBc
OUTPUTS	
Main Output	Adjustable from +3 dBm to +13 dBm into 50Ω (0.3V to 001V rms) with front-panel control or external dc voltage. Level maintained ±1 dB into 50Ω
Other Outputs	5 MHz at nominally 1V rms into 50Ω
Output Options	Rear Panel, Opt -04

MISCELLANEOUS	
Reference Frequency	External, 5 MHz at 0 dBm to +16 dBm into 50Ω
Level Control	External, 0.1 to 0.8V dc nominal into >2 kΩ produces an output level change of from +3 dBm to +13 dBm
Switching Speed	<800 µs to be within 50 Hz of final frequency (applies for frequencies from 80 MHz to 160 MHz. Improves at lower frequencies)
Internal 5 MHz Frequency Option -02, -05, or Other Source	**Option** **Aging Rate** -02 ±2 x 10^{-9}/day -05 ±5 x 10^{-6}/yr **Temp. Stability** 1 x 10^{-8}, 0°C to 50°C 1 x 10^{-6}, 0°C to 50°C

**Noise specifications are for frequencies from 80 MHz to 160 MHz. Noise performance improves or lower frequencies.*

*** Measured in a 30 kHz band excluding the 1 Hz band centered on the signal frequency.*

General Specifications

Altitude: To 3048 meters (10,000 feet), operating; 15,240 meters (50,000 feet), non-operating

Temperature: 0°C to 50°C, operating; -62°C to +70°C, non-operating

Relative Humidity: ≤80% to 50°C

Power: 115V or 230V ac ±10%, switch-selectable, 50 to 440 Hz. 80W

Size: 48.3 cm W x 17.8 cm H x 50.8 cm L (19 in x 7 in x 20 in)

Weight: 20.5 kg (45 lb)

Included: Manual, power cord, mating connector for programming input lines, serialized and dated calibration certificate

Ordering Information

Model

January 1989 prices

6160B* Frequency Synthesizer	$9950

Options (for 6160B)

-02* Frequency Std. 2x10^{-9}/day	1030
-04 Rear Panel RF Output	60
-05* Frequency Std. 5x10^{-6}/year	480
-522K 1120A Interface, field installable	325
-529** IEEE-488 Interface	380

** Option -02, -05 or an external 5 MHz timebase is required. Option -02 and -05 Frequency Standards are installable at Factory*

*** Requires 1120A IEEE-488 Translator. Includes 6XXXA-522K and Y7205 Cable*

Accessories (Also see page 485)

1120A IEEE-488 Translator	590
Y7205 6 ft Ribbon Cable for -522K	75
Y9111 3 ft (0.93m) 50Ω BNC Cable	20
Y9112 6 ft (1.85m) 50Ω BNC Cable	20
M07-205-600 7" Rack Adapter	110
M00-280-610 24" Rack Slides (Rack Adapter required)	130

Service & Support

Warranty

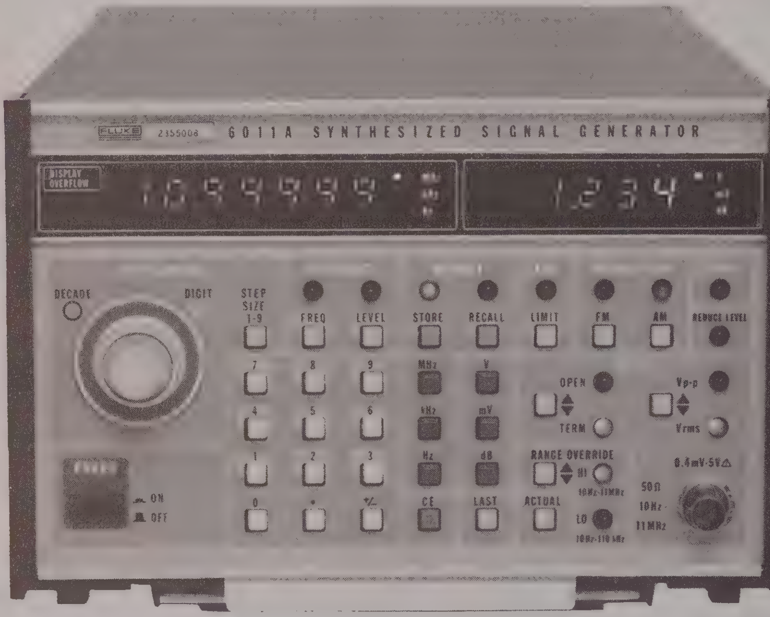
One-year product warranty. See page 470 for further information on warranty terms and conditions.

SC1-6160B Repair (w/calibration)	375
SC1-6160B Repair (cal w/in or out data)	410
SC1-6160B Repair (cal w/in and out data)	445
SC2-6160B Cal (1per yr recommended)	63
SC2-6160B Cal (1per yr w/in or out data)	98
SC2-6160B Cal (1 per yr w/in and out data)	133

6011A

GPIB
IEEE-488

RS-232



(NSN 6625-01-049-7760) **6011A**

6011A Signal Generator

0.1 Hz (7-digit) resolution to 110 kHz; 10 Hz resolution to 11 MHz
Storage of up to 9 different frequencies
Residual noise -50 dBc
Harmonics -35 to -50 dBc
Level flatness = 0.05 dB
Frequency switching 2 ms

The 6011A has an output impedance of 50 ohms (75 ohms optional) over the entire frequency range of 10 Hz to 11 MHz, selectable with 0.1 Hz (7-digit) resolution to 110 kHz, 10 Hz resolution to 11 MHz. Frequency is displayed using a 7-digit LED readout. The rms output voltage into a 50 ohm load ranges from 400 V to 5V or 10V rms into an open circuit or high impedance load. Referred to 1 milliwatt in a 50 ohm load, ranges from -55 dBm to <27 dBm.

The output may be in units of dBm, volts, or millivolts selected with 4-digit resolution using calculator-like front panel pushbuttons and displayed on LEDs. And the output level may be selected in terms of peak-to-peak voltage as well as rms voltage.

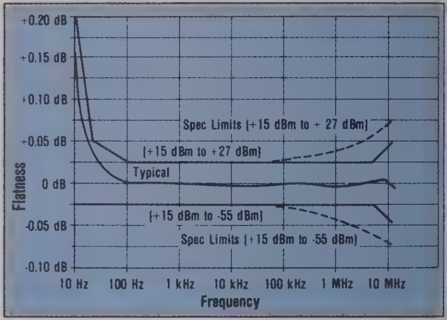
To avoid accidentally selecting an excessive output voltage, a limit may be stored in the 6011A. In addition, you may store up to nine different frequencies and/or output levels that may be recalled at random, quickly and without error — an important consideration for repetitive testing.

Selecting seven-digit frequency resolution is automatic — you don't need to select the high or low range or all seven digits when ending digits are zero. However, you may deliberately override the automatically-selected range when desirable.

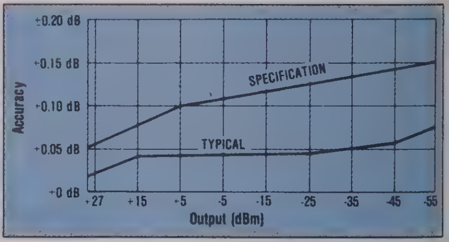
Any selected frequency may be increased or decreased in steps of practically any size, using the EDIT controls. This provides a manual sweep capability for checking frequency response, peaks, nulls, etc. A frequency or output level may be stored as a reference with other frequencies or levels added or subtracted within the instrument's range. This is useful for making relative measurements.

The 6011A can be controlled remotely and operate as part of a system. Option -05 makes the instruments compatible with GPIB/IEEE-488* and Option -06 gives them compatibility with EIA Standard RS-232-C. A seven-line ASCII bit-parallel interface is standard, when you don't order option -05 or -06. All front-panel functions are controllable remotely except for line power and open-terminated-load selection. The IEEE-488 Interface Option has the repertoire AH1, L2, RL1, and E1.

Output Level Flatness vs Frequency



Output Level Flatness vs Level



Specifications

Technical Specifications

Parameter	
FREQUENCY	
Low Range **High Range**	10 Hz to 109.9999 kHz 10 Hz to 10.99999 MHz
Range Selection	Automatic, with manual override
Resolution	0.1 Hz in the low range 10 Hz in the high range
Display	Seven-digit LED display of frequency set by local or remote control
Annunciation	Units automatically justified in the LED display to indicate maximum resolution

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Accuracy	±3 parts in 10^6 for one year over the temperature range of 0°C to +50°C
Aging Rate	<1 part in 10^6 per day of 1 part in 10^6 per year at constant temperature
Temperature	<±2 parts in 10^6 from 0°C to +50°C. (<±5 parts in 10^7 from 0°C to +50°C with Option -01)
External Reference	Requires a 10 MHz TTL compatible square wave with symmetry between 40% and 60%. Internal reference is automatically selected in the absence of an external reference
Local Control	Keyboard selection of numerical data, magnitude (Hz, kHz, MHz) and functions. Edit control provided for modifying entry. 6011A programmable in steps of 1-9
Frequency Storage	Facility to store and recall 9 front-panel control settings including frequency, level, modulation, and output terminal parameters
Remote Control	ASCII standard. IEEE-488 or RS-232-C Optional
Switching & Settling Time	Frequency settles to within 10 Hz of final frequency in low range and 1 kHz in high range in <2 ms in fixed form <34 ms in free form (excluding recall)
SPECTRAL PURITY	
Harmonic, Spurious	-30 dBc from 10 Hz to 100 Hz -50dBc from 100 Hz to 1 MHz -40 dBc from 1 MHz to11MHz (Except -35 dBc for output levels within 2 dB of max output from 5 MHz to 11 MHz). Total harmonic distortion from 100 Hz to 110 MHz). Total harmonic distortion from 100 Hz to 110 kHz is <0.15% (typically 0.07%) on low range and 0.3% (typically 0.1%) on high range
Non-Harmonic, Spurious	All non-harmonically related outputs <-60 dBc below output or -110 dBm whichever is greater
Phase Noise	-46 dBc as measured in a 30 kHz bandwidth excluding 1 Hz centered on the carrier, including the effects of the internal standard. Residual (excluding internal standard) is <-50 dBc. Approximately 8 dB improvement on low range
Phase Noise Spectral Density (Typical)	SSB Phase Noise at the output measured in a 1 Hz bandwidth at max output. Approx. 10 dB improvement on low range

Offset from Carrier	SSB Phase Noise
20 Hz	-102 dBc
200 Hz	-108 dBc
20 kHz	-106 dBc
1 MHz	-130 dBc

AMPLITUDE	
Impedance	50Ω (75Ω w/Option -10)
Range: dBm Volts	+26.98 dBm to -55.01 dBm into 50Ω 5.000V rms to 0.3972 mV rms into 50Ω
Local Control	Keyboard selection of output level in V, mV or dBm, Voltage is selectable in terms of V rms or V p-p and terminated or open circuit. Rotary knob provided for modifying entry and is programmable in steps of 1 through 9
Resolution	0.01 dB
Accuracy	See Graph
Frequency Response	See Graph
Stability vs. Temp	Typical temperature coefficient is 0.003 dB/°C, 20°C to 30°C ±0.2 dB, 0°C to 50°C
Switching & Settling Time	To within: ±1 dB, 150 ms fixed form, ±0.1 dB, 300 ms fixed form, ±0.01 dB, 450 ms fixed form. (Add 200 ms for free form.)
Display	dB; 4-digit LED plus sign in dBm or dB with respect to a stored dBm reference. Volts: 4-digit in V p-p or V rms; open circuit or terminated or volts or dB with respect to a stored voltage reference
AM Modulation	Analog input can be used to provide amplitude modulation. Bandwidth of this input is 10 kHz and max modulation is 90%. Z in = 600Ω 9V p-p corresponds to 90% modulation
Remote Control	ASCII standard. IEEE-488 or RS-232-C Optional
REMOTE INTERFACES	
Standard	Byte serial, bit parallel, seven ASCII-defined parallel lines, plus two handshake lines. Mating Connector Amphenol 57-30240. Also Option -05 and -06
OUTPUTS	
TTL Output	TTL-compatible square wave output (<0.5V to >2.4V p-p into 50Ω) at the synthesized output frequency
Reference Outputs	Derived from the synthesizer frequency reference. 1 MHz output is standard; 5 or 10 MHz available by changing internal jumper. Output is TTL-compatible square wave
Rear Panel Output	Option -04
20 to 31 MHz Tracking	Option -09

Option Specifications

High Performance TCXO Option (-01)

Frequency Accuracy: ±1.5 parts in 10^6 for one year over the temperature range of 0°C to +50°C
Aging Rate: <1 part in 10^8 per 24 hours at constant temperature, or 1 part in 10^6 per year
Temperature Dependence: <±5 parts in 10^7 from 0°C to +50°C

Phase-Lockable Input Option (-02)

Input Frequency: 1, 2, 2.5, 5, or 10 MHz
Input Level: >100 mV, <5V rms into 50Ω. May be used with either the standard oscillator or Option -01. Locking range is ±5 parts in 10^6 from frequency of internal oscillator

Frequency Modulation Option (-03)

General	High Range	Low Range
Deviation	±20 kHz	±200 Hz
Input	1V for 4 kHz ±5V max	1V for 40 Hz ±5V max
Accuracy 0 to 50°C	±1.5 kHz	±15 Hz
Rate	dc to 10 kHz	dc to 10 kHz
Linearity at Constant Temp	±1 kHz	±10 Hz
Stability at Constant Temp	±400 Hz	±4 Hz
Incidental AM Typical	<1%	<0.5%
Impedance, Input	600Ω	600Ω

IEEE-488 Interface Option (-05)

Compatible with IEEE Std 488-1978 for use in instrumentation systems. Interface functions are AH1, L2, RL1, and E1

RS-232-C Interface Option (-06)

Bit serial interface compatible with EIA Standard RS-232-C. Asynchronous data rates from 110 to 9600 baud. Either voltage-level interface or 20 mA current loop. 32-character FIFO buffer

General Specifications

Altitude: To 3048 meters (10,000 feet) operating
Temperature: 0°C to 50°C, operating; -40°C to 75°C, non-operating
Relative Humidity: ≤80% to 50°C
Power: 15V or 230V ac ±10%, 50 to 60 Hz, 100W, standard. Also 50 to 400 Hz optional and 100V ac optional
Size: 13.3 cm H x 21.6 cm W x 48.2 cm D (5.25 in x 8.5 in x 19 in)
Weight: 11.4 kg (25 lb)
Safety: CSA 556B certified
Included: Instruction Manual, power cord, serialized and dated calibration certificate

6011A

Ordering Information

Models

January 1989 prices

6011A Synthesized Signal Generator	$6495

Options (for 6011A)

-01 High Performance TCXO	380
-02[1] Phase Lock Input	380
-03*[1] Frequency Modulation	1000
-04* Rear Panel Output	35
-05*[2] IEEE-488 Interface	365
-06*[2] EIA Standard RS-232-C Interface	665
-07 50-400 Hz Line Power	495
-08 100V, 50-60 Hz Line Power	375
-09 20-31 MHz Tracking Output	60

**Options -01, -02, -07, and -08 are installed at factory or service center only. Order -03K, -09K, -05K, or -09K kits for customer installation*

[1] Cannot have -02 and -03 options together

[2] Cannot have -05 and -06 options together

Accessories (Also see page 485)

Y9111 3 ft (0.93m) 50Ω BNC to BNC Cable	$20
Y9112 6 ft (1.85m) 50Ω BNC to BNC Cable	20
M05-203-601 5-1/4" Rack Adapter, Offset	130
M05-203-602 5-1/4" Rack Adapter, Centered	130
M05-200-603 5-1/4" Rack Adapter, Dual	115
M00-203-631 5-1/4" Rack Adapter, w/18" Slides	295
PM 21XX Modular GPIB Switching System	see page 380
PM 2122 50 Ω coaxial switch	see page 382
PM 2240 TestTeam Software	see page 374

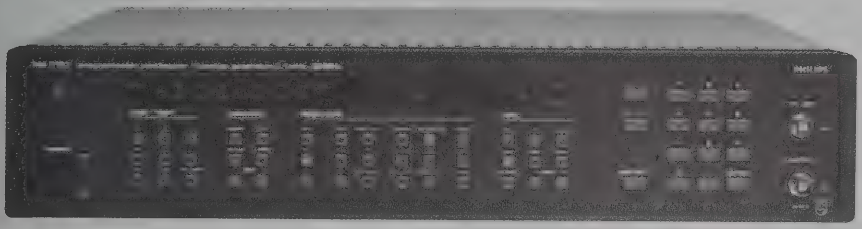
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions

Extended Warranty

SC1-6011A Repair (w/calibration)	398
SC1-6011A Repair (cal w/in or out data)	473
SC1-6011A Repair (cal w/in and out data)	548
SC2-6011A Cal (2 per yr recommended)	208
SC2-6011A Cal (2 per yr w/in or out data)	358
SC2-6011A Cal (2 per yr w/in and out data)	508



PM 5193

PM 5193 50 MHz Programmable Synthesizer/Function Generator

- 8 standard waveform outputs (operator programmable)
- Wide 0.1 mHz to 50 MHz frequency range
- Maximum 20Vpp output plus TTL output
- Completely independent AC and DC settings
- Full 8-digit resolution with clear, unambiguous LED readout panel
- Remote control of all programmable functions via GPIB/IEEE-488 interface
- Comprehensive modulation facilities including FM, AM, GATE, SWEEP, BURST

Wherever a high-stability, high-reproducibility frequency and function generator is required for testing, production control or driving frequency-dependent equipment, the PM 5193 is an unbeatable choice. Its versatile capability for generating standard functions, plus a broad frequency range extending from 0.1 mHz to 50 MHz, cover the requirements of virtually every situation.

The PM 5193 is today's most cost-effective multi-functional combination of programmable frequency synthesizer and function generator.

11-1/2 Decade Frequency Range

The frequency range of the PM 5193 covers a full 11-1/2 decades, from 0.1 mHz to 50 MHz. And to make working with this high-precision instrument as simple as possible, no less than 8 different waveforms are directly selectable. That includes standard functions like sine, squarewave, sawtooth and ramps, as well as important extras like pulse; both positive and negative; and haversine.

Instantly Selectable Modulation Modes

All required modulation modes are also instantly available at the touch of a button, covering AM, FM, sweep, burst and gating. Parameters like start and stop frequencies, amplitude and DC offset are easily programmable. And up to 10 complete front panel settings can be stored in non-volatile memory for instant recall whenever they are needed.

Precision and Stability

High precision and stability are essential factors in an instrument of this class. A crystal oscillator serves as a reference standard for all generated frequencies and provides an extremely high standard of accuracy. This feature, together with outstanding long-term stability ensures the extremely high level of repeatability that is one of the fundamental characteristics of the PM 5193.

Frequency resolution is a full 8 digits, so that advantage can be taken of the PM 5193's inherently high precision; useful in the identification and measurement of phenomena occurring at precisely defined frequencies.

GPIB Compatibility

Full GPIB/IEEE-488*/IEC-625 bus compatibility adds an important extra dimension to the PM 5193's versatility. All functions are remotely selectable, and all settings and status data can be transmitted to a remote controller and recalled whenever required.

The PM 5193 combines powerful user-features combined with operational simplicity. The front panel is divided into clear, separate keypad areas, and three informative LED displays show frequency, modulation parameters, output level and status, at a glance.

Local Button

The Local button provides a remote lock-out facility, so that manual changes can be made to current settings.

Waveform Selection

The Waveform keypad area allows selection of the PM 5193's 8 standard waveforms: sine, pulse (positive and negative), squarewave, haversine, triangle and sawtooth (positive and negative). The additional AC off button switches-off AC components, so that only the DC offset of a waveform (where selected) is output.

All buttons have an LED indicator to show at a glance which functions are selected, as well as to provide a warning of functions for which entries are incomplete.

Waveform Output Levels

Key symbol	Waveform	Max. frequency	Output Vpp (open loop)
∿	Sine	50 MHz	0...20
⊓	Positive pulse	50 MHz	1...10
⊔	Negative pulse	50 MHz	1...10
⊓⊔	Squarewave	20 MHz	2...20
∼	Triangle	200 kHz	0...20
∧	Haversine	50 kHz	0...10
⟍	Positive sawtooth	20 kHz	0...10
⟋	Negative sawtooth	20 kHz	0...10

Frequency Selection

The frequency keypad area is used for precise programming of all frequency-related settings, including continuous wave frequencies, sweep start and stop frequencies, choice of Hz/kHz, and Δ frequency programmable step widths for discrete frequency steps. The preset frequency steps can then be repeated manually in either direction using the step + or - buttons.

Start and stop frequency values are programmed via the numeric keyboard, where they are input using the Enter button. The rub out key in the numeric keypad allows values to be corrected before entry.

The maximum frequency resolution is 0.1 mHz, and a total resolution of 8 digits is always available.

Sweep Modes

The PM 5193 has several sweep capabilities for testing, in a broad range of applications such as PHase Lock Loops, Amplifiers, IF units, Filters etc. All sweep parameters are programmed via the keyboard, for example start frequency, stop frequency, sweep time, linear or logarithmic, and single or continuous sweep. There are 3 sweep modes - in each case, the output waveform is shown for single shot and continuous.

The PM 5193 can be programmed to have the start frequency higher than the stop frequency or vice versa (see figure 1). For single shots, when the stop frequency is reached, the output remains at the stop frequency with no flyback until the "single" key (t_1) is pressed. The continuous sweep is the same as in sweep

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 5193

mode 1 (See figure 2). As the figures demonstrate, in this mode a complete sweep takes double the programmed sweep time (See figure 3). With these three sweep modes you have more than 20 sweep possibilities. Sweep range is from 1 Mhz to 50 MHz with times programmable between 10 ms...999 s.

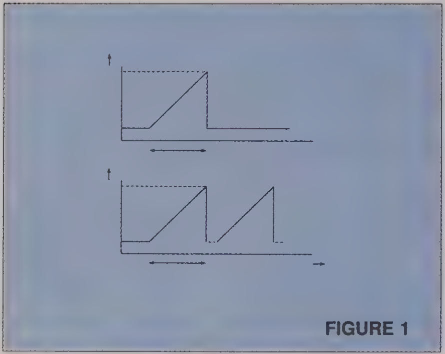


FIGURE 1

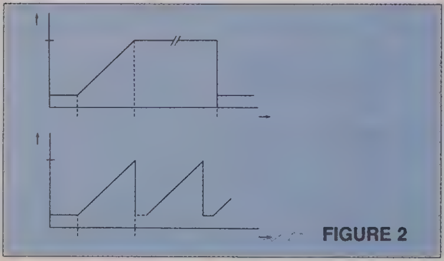


FIGURE 2

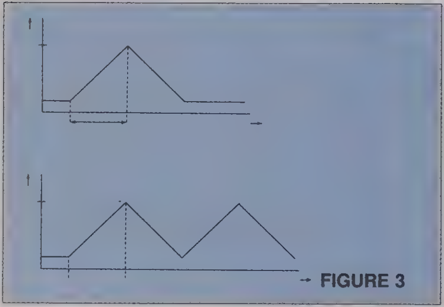


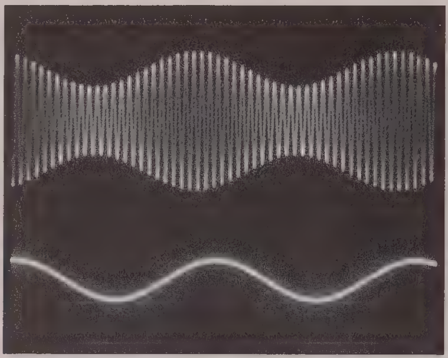
FIGURE 3

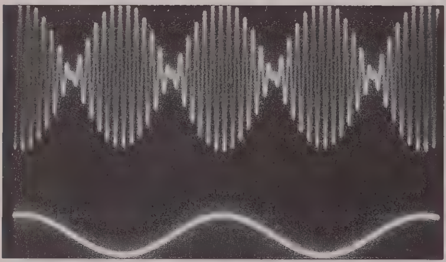
Modulation Modes

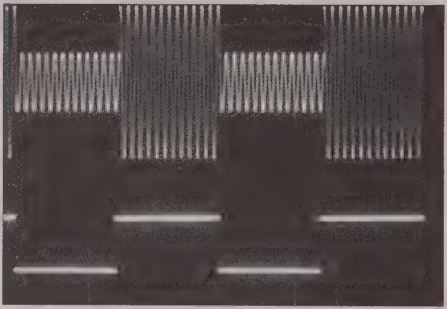
The PM 5193 has various modulation modes such as AM, FM, burst etc., including AM internal and AM external.

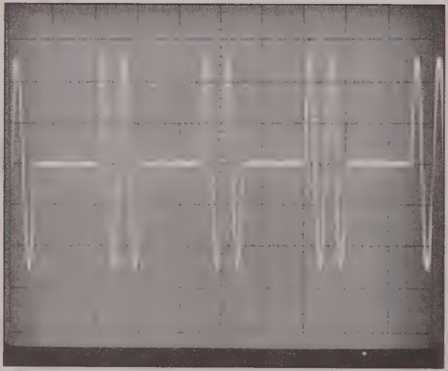
In AM external mode the carrier can be modulated with a frequency between DC and 200 kHz. This DC coupled modulation input allows modulation of the carrier not only with a sinewave but also with a square wave, triangle or superposed sine. With a superposed sinewave (DC + -1,4 Vn generate Amplitude Modulation with suppressed carrier.

The carrier can also be modulated with an external square wave, giving pulse modulation. On-off amplitude ratio is adjusted using the external square wave.









Burst signal, programmable on/off cycles; 2 on, 3 off cycles.

Output Level Setting

Selection of output levels in Vpp, Vrms or dBm is by means of a special keypad, and the selected output voltage is shown on the 3-digit LED display. The step function (Δ level) allows quick output-level changes in user defined steps. The nominal maximum outputs are waveform-dependent (see table).

Signal outputs, including a TTL output, are short-circuit-proof and located on the front panel.

Specially developed circuitry prevents any interaction between AC and DC settings within a ±10V window. These settings are therefore independent of each other within this window. A warning is given by a flashing key LED if any combined AC + DC setting exceeds the maximum preset output level.

Store and Recall Functions

The store and recall buttons allow up to 10 complete front panel settings to be stored and recalled at any time. The last front panel setting is automatically stored under '0', so that work can conveniently be resumed with the same settings in the next session. Up to nine additional settings can be stored in locations 1 - 9. Settings are stored in a non-volatile memory with battery back-up, providing assured storage over an extended period.

Wide Choice of Waveforms and Modulation Modes

Setting of the outputs is fast, simple and extremely logical using one set of pushbuttons grouped into four function fields for waveform, frequency, modulation and ouput characteristics, plus a common keyboard for entry of numeric values. Each function key has a built-in LED to indicate activation.

All the selected values are displayed on a bright, clear LED display for immediate and unambiguous readout showing frequency (8 digits), modulation parameter (4 digits) and output level or DC offset (3 digits).

Function selection can also be done remotely, for example from a system controller, through the built-in IEEE-488/IEC-625 interface. When the IEEE-488/IEC-625 bus facility is in use, the relevant address can be shown in the 3-digit LED display.

PM 5193's built-in capability to operate as a programmable "stand-alone" continuous wave pulse generator adds more versatility in everyday operation. Frequency range in this mode is up to 50 MHz, with a typical rise and fall time of 3 ns. The pulse generator can be programmed for positive or negative pulses, and the duty cycle is fixed at 50%.

Other features include AC output dimensions selectable as Vpp, Vrms or dBm; phase-continuous sweep over all 10 frequency decades; independent AC and DC settings; and a TTL output conveniently located on the front panel.

IEEE-488 Address Setting

Setting of an IEEE-488 system address is carried out very conveniently by a direct-entry keyboard, instead of the usual DIP switches (which in many cases are inaccessibly located on a rear panel or inside the instrument cabinet). With the PM 5193, all that is necessary is to activate the "address" key. The current address is then displayed, and a new address can be programmed if required.

As well as the PM 5193's comprehensive stand-alone features, it also offers advanced facilities for operating within an automated testing system. This form of operation allows large numbers of automatic measurements to be performed continuously and with complete reproducibility, useful in quality control situations.

The instrument operates as a talker/listener, and can be remotely programmed for all manual and triggered functions, including SWEEP and (programmable) BURST. Moreover, the SERVICE REQUEST function can be generated to give error indications, END messages (e.g. for SWEEP and BURST in SINGLE SHOT mode).

A pushbutton-operated remote lock-out facility allows the user to lock-out the controller when making manual changes to the current setting. The IEEE-488 address is set via the numeric keyboard, and can be displayed on the 3-digit LED panel.

Learn and Identification Modes

PM 5193 has additional Learn and Identification modes to facilitate programming and operation in IEEE-488-bus environments.

Learn mode makes it possible to send a complete string of instructions representing any particular front panel settings to a controller. These settings can then be reproduced simply whenever required from the controller by the transmission of the corresponding string to the PM 5193. This mode reduces programming to a minimum, and contributes to the PM 5193's ease of integration into automated measuring systems.

In Identification mode, the PM 5193 automatically responds to an identification request from the controller by transmitting its type number and software version.

Rack Mounting Facilities

PM 5193 is supplied as standard with the necessary hardware for rack mounting, further increasing its flexibility in use. An optional RF output can also be supplied for rack-mounted system interconnection.

Rear Panel Connection Facilities

A number of additional connection facilities are provided on the rear panel of the PM 5193:

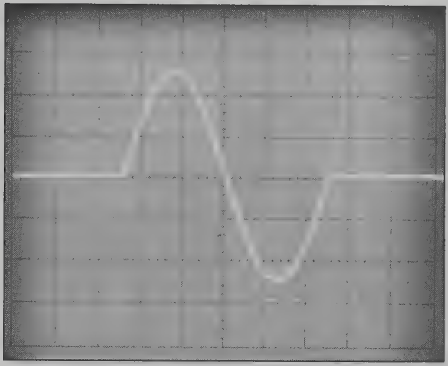
Inputs:

Ext clock: The PM 5193S can lock-on to external 10 MHz reference signals which are applied to this BNC connector. The PM 5193 can lock onto external reference signals from other PM 5191/5192/5193 generators (8.6 MHz).

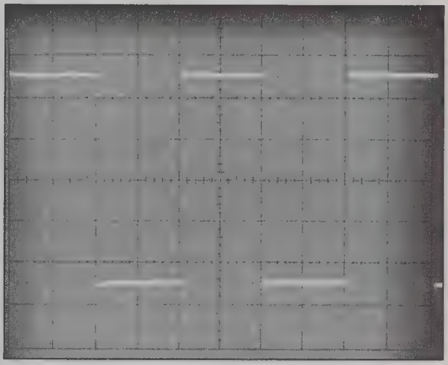
Modulation: The PM 5193's wide range of external modulation modes can be used by applying the modulation signal to this BNC connector.

Outputs:

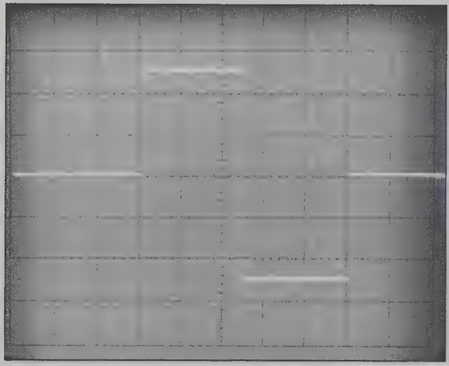
Int. clock: The reference frequency of (10 MHz or 8.6 MHz) is available at the int. clock connector. This frequency can be used for synchronization purposes.



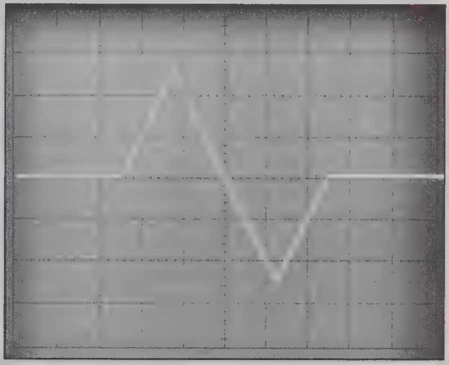
Sinewave



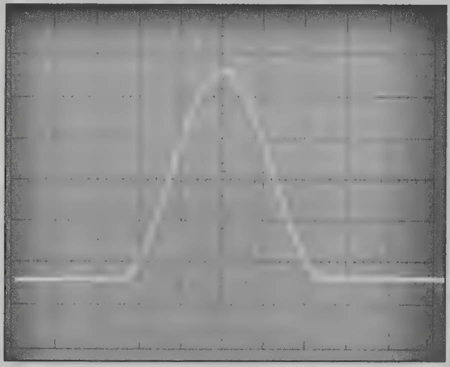
Positive and negative pulses with 3 ns transition time.



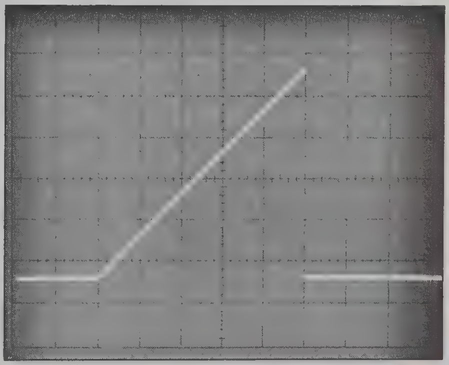
Squarewave



Triangle



Haversine (sine ^{2} signal)



Positive and negative ramps

Modulation: The signal output from the PM 5193's programmable modulation frequency source is available on this socket for triggering purposes.

Penlift + sweep: These two signals enable the PM 5193 to be connected directly to an X-Y recorder, for example for plotting the frequency response characteristics of filters.

IEEE-488 connector: For direct connection of the PM 5193 into IEEE-488-bus-oriented measuring systems. The shielded IEEE-488 connector provides optimal security against disturbance of IEEE-488 data.

Specifications

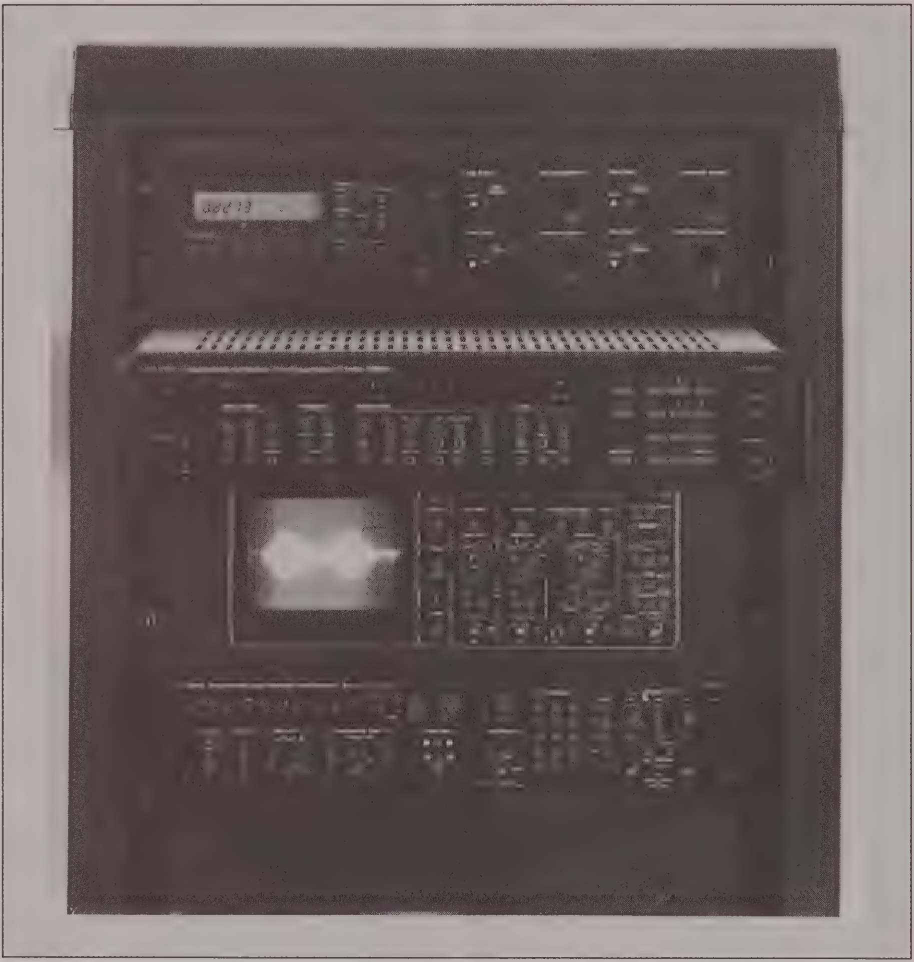
Technical Specifications

Frequency Characteristics

Nominal Range: 0.1 mHz - 50 MHz

Operational Range: Sinewave 50 MHz;
Positive pulse 50 MHz
Negative pulse 50 MHz
Squarewave 20 MHz;
Triangle 200 kHz;
Haversine 50 kHz
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz

PM 5193



PM 5193

Setting: Local via front-panel keyboard. Remote via IEEE-488 bus interface ± stepping function with programmable step width
Resolution: 8 digits; >0.1 mHz
Display: 8-digit LED display, Hz/kHz dimension LEDs
Setting Error: <1 x 10^{-6}
Frequency Jitter: <0.02% <1200 Hz f ≥2 MHz LF bandwidth 10 Hz - 20 kHz
Temperature Coefficient: <0.2 p.p.m./K
Aging: <1 p.p.m. per year
Drift: <0.3 p.p.m. in 7h

Output Characteristics

Main Output
Connector: BNC socket on front or rear panel
Impedance: Z_o +50Ω
Load Capability: Short-circuit proof
Max. External Voltage: ±12 Vpp (<3 min.)

AC Voltage
Independent of DC settings within ±10V window
Ranges: I 2.1 - 20 Vpp open-circuit voltage;
II 0.21 - 2.00Vpp open-circuit voltage;
III 0 - 0.200Vpp open-circuit voltage
Resolution: Range I 0.1V; Range II 0.01V; Range III 0.001V
Setting: Remote or local +/- stepping Programmable step width
Alternative Settings: Vrms, dBm
Basic Setting Error: ±2% (1 Hz - 200 kHz) Vpp >2.1V

DC Voltage
Independent of AC setting within ±10V window
Range: ±10V open-circuit voltage
Resolution: 0.1V
Error: ±2% of setting
Offset: <0.03V (Vac ≤2V);
<0.08V (Vac >2V)
Setting: Remote or local; +/- stepping function. Programmable step width

TTL Output
Connector: BNC socket on front panel
Fan-Out: <5 TTL inputs
Level: 0/>3.5V

Waveforms

Standard Functions: Sinewave, squarewave, triangle, haversine, sawtooth (positive- and negative-going ramps), positive and negative pulse
Selection: Local via front panel keyboard. Remote via IEEE-488 bus interface
Indication: Key LEDs

Sinewave
Frequency Range: 0.1 mHz...50 MHz
Output Range: 0...20 Vpp

Distortion
THD: <0.35% (1 Hz< f <200 kHz, open circuit voltage: <12 Vpp range I, <1.2 Vpp range II, <0.12 Vpp range III)
Harmonics: <-37 dBc (200 kHz< f <10 MHz, open circuit voltage ≥10 mVpp)
Spurious: <-40 dBc (2 MHz< f <50 MHz, open circuit voltage ≥100 mVpp, distance from carrier <15 kHz)
<-50 dBc (0.1 mHz< f <2 MHz, open circuit voltage ≥100 mVpp, distance from carrier >15 kHz)

Haversine
Frequency Range: 0.1 mHz...50 kHz
Output Range: 0...10Vpp
Distortion: <0.8% (output >10 mVpp)

Squarewave
Frequency Range: 0.1 mHz - 20 MHz
Transition Times: 10 ns typically, <11.5 ns
Duty Cycle: 50%
Abberration: <2% ±3 mV range II;
<2% ±20 mV range I

Triangle
Frequency Range: 0.1 mHz - 200 kHz
Output Range: 0 - 20 Vpp
Temperature Coefficient: <0.1%/K
Linearity: >99%

Sawtooth (pos/neg ramps)
Frequency Range: 0.1 mHz - 20 kHz
Output Range: 0 - 10 Vpp
Temperature Coefficient: <0.1%/K
Flyback Time: <1 +s
Linearity: <99%

Pulse
Frequency Range: 0.1 mHz...50 MHz
Output Range: 1.0...10Vpp
Rise/Fall Time: 3 ns (typically <4.5 ns)
Aberration: <2% ±40 mV

Modulation

Modes: AM int./ext., FM int./ext.,lin./log. sweep, gate int./ext., burst
Internal modulation frequency programmable via keypad
Resolution: Range I (0.01 - 0.99 kHz): 10 Hz
Range II (1.0 - 9.9 kHz): 0.1 kHz
Range III (10 - 200 kHz): 1.0 kHz

Internal AM
Carrier Frequency: 0.1 mHz - 50 MHz carrier wave: all except pulses
Modulation Frequency: 10 Hz...200 kHz
Modulation Depth: 0 - 100%
Resolution: 1%
AM Envelope Distortion: <2% (m ≤98%); <1.5% (m <50%)

External AM
Modulation Frequency: 0 - 200 kHz
AM Envelope Distortion: 1.5% (m <98%); 1% (m <50%)

Internal FM
Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz...200 kHz
Deviation: 10 kHz...200 kHz
Resolution: 1 kHz
Modulation Distortion: <1% (f ≤30 MHz; Δf ≤100 kHz; fm ≥200 Hz and ≤50 kHz)

External FM
Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz...200 kHz
Deviation: 10 kHz...200 kHz
Distortion: <1%

Sweep
Carrier Wave: All waveforms
Sweep Functions: lin./log., up/down, single/continuous, hold/release
Range: 1 mHz...50 MHz phase-continuous, depending on waveform; independent setting of start and stop frequencies
Sweep Time: 10 ms - 999s
Resolution: Max. 0.01s (3 digits)
Error: 0.1 ms

Internal Gate
Non-phase-coherent signal keying
Carrier Frequency: 0.1 mHz - 50 MHz (depending on waveform): carrier wave: all except pulses
Modulation Frequency: 10 Hz...200 kHz
Duty Cycle: 50%

External gate
Modulation Frequency: 0...500 kHz; min. on/off time 2 µs

Burst
Carrier Frequency: <2 MHz (depending on waveform) all carrier waveforms
On and Off Cycles: 1...200 programmable
Burst Functions: Single/continuous
External Triggering: TTL positive edge; via modulation input
Max. Frequency: 1 kHz

Video Modulation (PM 5193V only)
Carrier Waveform: sine
Carrier Frequency: ≤50 MHz
Modulation Bandwidth (-1 dB): ≥8 MHz; carrier frequency <45 MHz
External Modulation Signal: CVBS; amplitude: 1 Vpp
Max. DC Offset: ±5V
Modulation Mode: Double sideband amplitude modulation (A3F), negative polarity
RF Synchronizing Level: 100%
Residual Level (white level): 11 ±3%; related to RF synchronizing level
Independent Linearity Error: ≤2% between black and white level

Connector: BNC; "VIDEO IN" at rear of the instrument
Impedance: 75Ω

IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics
Interface Functions: AH1, L4, RL1, SR1, SH1, T6
Listener Address: Programmable via keyboard, indicated by LED display
Address Range: 0...30
Service Request: Error and single sweep end message
Remote Lock-Out: Go-to local front panel key
Device Identification and learn modes provided as standard

10 MHz Output (PM 5193S only)
Protection: Short-circuit proof, max. external voltage 10V
Frequency: 10 MHz (squarewave)
Level: Typ. 2 dBm >0 dBm
Impedance: 50Ω

External Reference Input (PM 5193S only)
Maximum Voltage: ±5V
Waveform: sine or square
Frequency: $\frac{10\ \text{MHz}}{N}$ N = 1, 2, 3...10 for synchronization purposes
Lock-In Time: <2s
Lock-In Range: ±0.1% - a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency
Level: 0 - 20 dBm
Impedance: 50Ω

General Specifications

Miscellaneous

Non-Volatile Memory: 1 memory location for last setting. 9 Memory locations for programmable settings.
Rear Connectors: Modulation output BNC; Sweep output BNC; Pen-lift output BNC; Clock output BNC; Modulation input BNC; Clock input BNC; IEEE-488 bus connector; Mains connector

Operating Conditions

Reference Temp.: +23°C ±1°C
Operating Temp.: +5°C...+40°C
Storage Temp.: -20°C...+70°C

Power Requirements

Line Voltage: 100, 120, 220, 240V, tolerance ±10%
Line Frequency: 50 - 60 Hz, tolerance ±5%
Power Consumption: 105W
Size: 105 mm H x 440 mm W x 430 mm L. (4.1 in H x 17.3 in W x 15.6 in L). Rack mounting facility standard (2 units high)
Weight: 10.5 kg (23 lb)
Included with instrument: Operating manual, programming card, rack mounting brackets

Ordering Information

Model

	January 1989 prices
PM 5193M Programmable Synthesizer/Function Generator	$4600
PM 5193SM Programmable Synthesizer/Function Generator with 10 MHz Reference Input	4895
PM 5193VM Programmable Synthesizer/Function Generator with video modulation	5895

Option

Rear Panel Output	consult factory

Accessories (Also see page 485)

PM 9581/01 50Ω Feed-through Termination 3W	65
PM 9585/01 50Ω Feed-through Termination 1W	30
PM 2295/05 IEEE-488 Cable .5m	150
PM 2295/10 IEEE-488 Cable 1m	155
PM 2295/20 IEEE-488 Cable 2m	170
PM 2296/50 IEEE-488 to IEC-625 Adapter	70
PM 2296/60 IEC-625 to IEEE-488 Adapter	80
PM 9051 BNC to 4 mm Banana Adapter	9
PM 21XX Modular GPIB Switching System	see page 380
PM 2122 50 Ω coaxial switch	see page 382
PM 223X Instrument Drivers Software	see page 376
PM 2240 TestTeam Software	see page 374

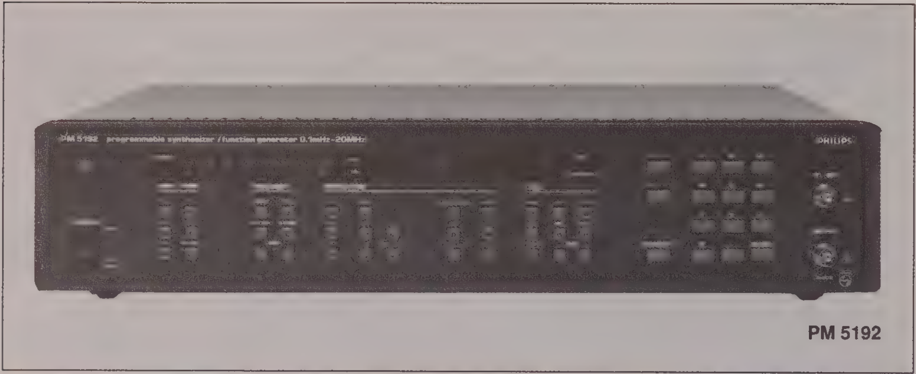
Service & Support

Warranty
One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 5192

GPIB
IEEE-488



PM 5192

PM 5192 20 MHz Synthesizer/Function Generator

- Five standard waveform outputs
- Crystal-controlled precision and stability 0.1 mHz to 20 MHz frequency range
- Maximum 20 Vpp output plus TTL output
- Completely independent AC and DC settings
- Full 8-digit resolution with clear LED read out
- Remote control of all programmable functions via GPIB/IEEE-488 interface
- Modulation facilities include AM, FM, GATE, SWEEP

The PM 5192 is a precision frequency source with the assurance of long-term stability and reproducibility. A crystal oscillator serves as a reference for the generated frequencies, ensuring that the PM 5192 will always continue to provide the selected frequency to a very high standard of accuracy.

Setting error is negligible at <1 x 10-6, and the exceptionally low aging figure of <1 p.p.m/year makes the PM 5192's accuracy a true reference standard for applications in R & D, production-line testing and quality control, and many other fields of engineering.

The PM 5192's frequency range extends from 0.1 mHz to 20 MHz (actual range depends on selected waveform). Output voltages are continuously adjustable up to 20 Vpp, and can be expressed in Vpp, Vrms or dBm.

Frequency resolution is a full 8 digits, a figure that represents only 1 Hz in 20 MHz, allowing full advantage to be taken of PM 5192's very high precision, useful in the identification and measurement of phenomena occuring at precisely defined frequencies.

A choice of five different waveforms covers almost all standard-function requirements, with sine, square wave, triangle and sawtooth (positive- and negative-going).

The PM 5192's outstanding capabilities and precision are combined with an economic cost, making this instrument an attractive, general-purpose tool for a very wide range of different applications.

Programmable Parameters

Parameters like start and stop frequencies, amplitude and DC offset are easily and quickly programmed using the front panel keyboard. And for still more convenience and time saving, up to 10 complete front panel settings can be stored in non-volatile memory for instant recall whenever they are needed.

Also provided is a valuable sweep function, with independently programmable sweep parameters, allowing localization of areas of interest, followed by close examination of particular frequency bands of interest.

Compatibility

To increase versatility in use still further, the PM 5192 has full GPIB/IEEE-488* bus compatibility. All functions are remotely selectable via the bus, while settings and status data can be transmitted to a remote controller and recalled whenever required.

In this systems mode, large numbers of automatic measurements can be made continuously and with complete reproducibility, excellent for quality control applications. Manual setting changes can still be made using a push button-operated controller lock-out facility. IEEE-488 addresses are set via the numeric keyboard, and can be displayed on the LED display.

Waveform Selection

The waveform keypad area allows selection of PM 5192's 5 standard waveforms: sine, square wave, triangle and sawtooth (positive- and negative-going).

All buttons have an LED indicator to show at a glance which functions are selected, as well as to provide a warning of functions for which entries are incomplete.

Waveform Output Levels

Key symbol	Waveform	Max. frequency	Output Vpp (open loop)
∿	Sine	20 MHz	0...20
⎍	Square	20 MHz	0.2...20
⋀	Triangle	200 kHz	0...20
◿	Positive sawtooth	20 kHz	0...10
◺	Negative sawtooth	20 kHz	0...10

Precise Frequency Programming

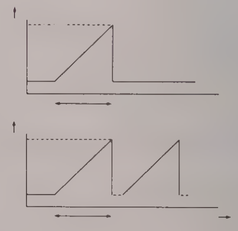
A frequency keypad area allows precise programming of frequency-related settings, including continuous wave frequencies, sweep start and stop frequencies, choice of Hz/kHz, and Δ freq. programmable for discrete frequency steps.

These preset frequency steps can then be repeated manually in either direction using the step + or - buttons.

Start and stop frequency values are programmed via the numeric keyboard, where they are input using the enter button. The rub-out key in the numeric keypad allows values to be corrected before entry. The maximum frequency resolution is 0.1 mHz, and a total resolution of 8 digits is always available.

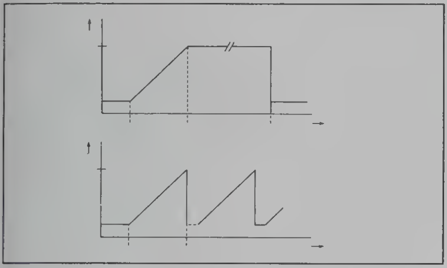
Sweep Modes

The PM 5192 has several sweep capabilities for testing, in a broad range of applications such as Phase Lock Loops, Amplifiers, IF units, Filters etc. All sweep parameters are programmed via the keyboard, for example start frequency, stop frequency, sweep time, linear or logarithmic, and single or continuous sweep. There are 3 sweep modes — in each case, the output waveform is shown for single shot and continuous.

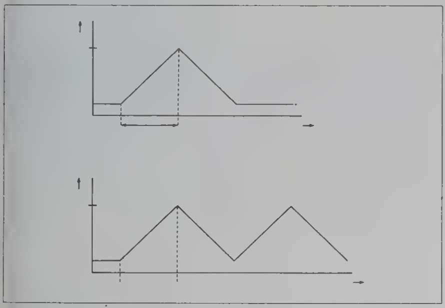


**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

The PM 5192 can be programmed to have the start frequency higher than the stop frequency or vice versa.



For single shots, when the stop frequency is reached, the output remains at the stop frequency with no flyback until the "single" key (t_1) is pressed. The continuous sweep is the same as in sweep mode 1.



As the figures demonstrate, in this mode a complete sweep takes double the programmed sweep time.

With these three sweep modes you have more than 20 sweep possibilities. Sweep range is from 1 MHz to 20 MHz with times programmable between 10 ms...999s.

Modulation Modes

The PM 5192 has various modulation modes such as AM, FM, burst etc., including AM internal and AM external.

In AM external mode the carrier can be modulated with a frequency between DC and 200 kHz. This DC coupled modulation input allows modulation of the carrier not only with a sinewave but also with a square wave, triangle or superposed sine. With a superposed sinewave (DC = -1.4V) you can generate Amplitude Modulation with suppressed carrier.

The carrier can also be modulated with an external square wave, giving pulse modulation. On-off amplitude ratio is adjusted using the external square wave.

Output Level Setting

Selection of output levels in Vpp, Vrms or dBm is by means of a special keypad, and the selected output voltage is shown on the 3-digit LED display. The step functions (Δ level) allows quick output-level changes in user defined steps. The nominal maximum outputs are waveform-dependent (see table).

Signal outputs, including a TTL output, are short-circuit-proof and located on the front panel.

Specially developed circuitry prevents any interaction between AC and DC settings within a ±10V window. These settings are therefore independent of each other within this window. A warning is given by a flashing key LED if any combined AC + DC setting exceeds the maximum preset output level.

Store and Recall Functions

The store and recall buttons allow up to 10 complete front panel settings to be stored and recalled at any time. The last front panel setting is automatically stored under '0', so that work can conveniently be resumed with the same settings in the next session. Up to nine additional settings can be stored in locations 1 - 9. Settings are stored in a non-volatile memory with battery back-up, providing assured storage over an extended period.

GPIB/IEEE-488 Address Setting

Setting of an IEEE-488 system address can be done locally, via the front panel. With the PM 5192, all that is necessary is to activate the 'address' key. The current address is then displayed, and a new address can be programmed if required.

Learn and Identification Modes

Learn and identification modes facilitate programming in system environments. In Learn mode, instruction strings for front panel settings can be up-loaded to a controller for later recall, avoiding the need for manual re-programming. In Identification mode, the PM 5192 responds to controller identification requests with its type number and software version. Rack-mounting fittings are supplied as standard, further increasing versatility in system environments.

Rear Panel Connection Facilities

A number of additional connection facilities are provided on the rear panel of PM 5192:

Inputs

Ext clock: PM 5192S can lock on to external reference signals (10 MHz) which are applied to this BNC connector.

The PM 5192 can lock on to external reference signals from other PM 5191/2/3 generators (8.6 MHz).

Modulation: External frequencies applied to this BNC connector can modulate the carrier in any of PM 5192's modulation modes (AM, FM, gating), or can be used for trigger purposes.

Outputs

Int. clock: The reference frequency (10 MHz or 8.6 MHz) is available at the int. clock connector. This frequency can be used for synchronization purposes.

Modulation: The signal output from PM 5192's programmable modulation frequency source is available on this socket for triggering purposes.

Penlift + Sweep: These two signals enable PM 5192 to be connected directly to an X-Y recorder, for example for plotting the frequency response characteristics of filters.

IEEE-488 Connector: For direct connection of PM 5192 into IEEE-488-bus-oriented measuring systems. The shielded IEEE-488 connector provides optimal security against disturbance of IEEE-488 data.

Specifications

Technical Specifications

Frequency Characteristics

Nominal Range: 0.1 mHz - 20 MHz

Operational Range:

Sinewave 20 MHz;

Squarewave 20 MHz;

Triangle 200 kHz;

Positive sawtooth 20 kHz;

Negative sawtooth 20 kHz

Setting: Local via front-panel keyboard. Remote via IEEE-488 bus interface +/- stepping function with programmable step width

Resolution: 8 digits; >0.1 mHz

Display: 8-digit LED display, Hz/kHz dimension LEDs

Setting Error: $<1 \times 10^{-6}$

Frequency Jitter: <0.01% <500 Hz f ≥2 MHz LF bandwidth 10 Hz - 20 kHz

Temperature Coefficient: <0.2 p.p.m./K

Aging: <1 p.p.m. per year

Drift: <0.3 p.p.m. in 7h

Synchronization: 2 (or more) PM 5192 generators can be synchronized by rear socket connection

Output Characteristics

Main Output

Connector: BNC socket on front or rear panel

Impedance: Z_o +50Ω

Load Capability: Short-circuit proof

Max. External Voltage: ±12 Vpp (<3 min.)

AC Voltage

Independent of DC settings within ±10V window

Ranges: I 2.1 - 20 Vpp open-circuit voltage;
II 0.21 - 2.00V open-circuit voltage;
III 0 - 0.200V open-circuit voltage

Resolutions: Range I 0.1V;
Range II 0.01V;
Range III 0.001V

Setting: Remote or local +/- stepping
Programmable step width

Alternative Settings: Vrms, dBm

Basic Setting Error: ±2% (1 Hz - 200 kHz), range >2.1V

DC Voltage

Independent of AC setting within ±10V window

Range: +/- 10V open-circuit voltage

Resolution: 0.1V

Error: ±2% of setting

Offset: <0.03V (Vac ≤2V); <0.08V (Vac >2V)

PM 5192

Setting: Remote or local; +/- stepping function. Programmable step width

TTL Output
Connector: BNC socket on front panel
Fan-Out: <5 TTL inputs
Level: 0/>3.5V

Waveforms

Standard Functions: Sinewave, squarewave, triangle, sawtooth (positive- and negative-going ramps)
Selection: Local via front panel keyboard. Remote via IEEE-488 bus interface
Indication: Key LEDs

Sinewave
Frequency Range: 0.1 mHz...20 MHz
Output Range: 0...20 Vpp

Distortion
THD: <0.35% (1 Hz< f <200 kHz, open circuit voltage <12 Vpp range I, <1.2 Vpp range II, <0.12 Vpp range III)
Harmonics: <-37 dBc (200 kHz< f <10 MHz, open circuit voltage ≥10 mVpp)
Spurious: <-40 dBc (2 MHz< f <20 MHz, open circuit voltage ≥100 mVpp, distance from carrier >15 kHz); <-50 dBc (0.1 mHz< f <2 MHz, open circuit voltage ≥100 mVpp, distance from carrier >15 kHz)

Squarewave
Frequency Range: 0.1 mHz - 20 MHz
Transition Times: 10 ns typical, <11.5 ns
Duty Cycle: 50%
Abberration: <2% ±3 mV range II; <2% ±20 mV range I

Triangle
Frequency Range: 0.1 mHz - 200 kHz
Output Range: 0 - 20 Vpp
Temperature Coefficient: <0.1%/K
Linearity: >99%

Sawtooth (pos/neg ramps)
Frequency Range: 0.1 mHz - 20 kHz
Output Range: 0 - 10 Vpp
Temperature Coefficient: <0.1%/K
Flyback Time: <1 µs
Linearity: >99%

Modulation

Modes: AM int./ext., FM int./ext.,lin./log. sweep, gate int./ext. Internal modulation frequency 1 kHz programmable via keypad

Internal AM
Carrier Frequency: 0.1 mHz - 20 MHz
Modulation Frequency: 1 kHz
Modulation Depth: 0 - 100%
Resolution: 1%
AM Envelope Distortion: <2% (m ≤98%); <1% (m <50%)

External AM
Modulation Frequency: 0 - 200 kHz
AM Envelope Distortion: 1.5% (m <98%); 0.7% (m <50%)
Imp of Mod Source: ≤50Ω

Internal FM
Carrier Frequency: >2 MHz
Modulation Frequency: 1 kHz
Deviation: 10 kHz - 200 kHz
Resolution: 1 kHz
Modulation Distortion: <1% Δf ≤100 kHz

External FM
Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz - 200 kHz
Deviation: 10 kHz - 200 kHz
Distortion: <1%
Imp of Mod Source: ≤50Ω

Sweep
Carrier Wave: All waveforms
Sweep Functions: lin./log., up/down, single/continuous, hold/release, triggered
Range: 1 mHz - 20 MHz phase-continuous, depending on waveform; independent setting of start and stop frequencies
Sweep Time: 10 ms - 999s
Resolution: Max. 0.01s
Error: 0.1 ms

Internal Gate
Non-phase-coherent signal keying
Carrier Frequency: 0.1 mHz - 20 MHz (depending on waveform)
Modulation Frequency: 1 kHz
Duty Cycle: 50%

External gate
Modulation Frequency: 0 - 500 kHz; min. on/off time 2 µs

10 MHz Output (PM 5192S only)
Protection: Short-circuit proof, max. external voltage 10V
Frequency: 10 MHz (squarewave)
Level: Typ. 2 dBm >0 dBM
Impedance: 500Ω

External Reference Input (PM 5192S only)
Maximum Voltage: ±5V
Waveform: sine or square
Frequency: $\frac{10\text{ MHz}}{N}$ N= 1,2,3,...10 for synchronization purposes
Lock-In Time: <2s
Lock-In Range: ±0.1% - a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency
Level: 0 - 20 dBM
Impedance: 50Ω

IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics
Interface Functions: AH1, L4, RL1, SR1, SH1, T6
Listener Address: Decimal programmable via keyboard, indicated by LED display
Address Range: 0 - 30
Service Request: Error and single sweep end message
Remote Lock-Out: Go-to local front panel key
Device Identification and learn modes provided as standard

General Specifications

Non-Volatile Memory: 1 memory location for current setting, 9 memory locations for programmable setting

Rear Connectors: Modulation output BNC; Sweep output BNC; Pen-lift output BNC; Clock output BNC; Modulation input BNC; Clock input BNC; IEEE-488 bus connector; Line connector

Operating Conditions

Reference Temp.: +23°C ±1°C
Operating Temp.: +5°C...+40°C
Storage Temp.: -20°C...+70°C

Power Requirements

Line Voltage: 100, 120, 220, 240V, tolerance ±10%
Line Frequency: 50 - 60 Hz, tolerance ±5%
Power Consumption: 100W
Size: 105 mm H x 440 mm W x 430 mm L. (4.1 in H x 17.3 in W x 16.9 in L)
Rack mounting facility standard (2 units high)
Weight: 10.5 kg (23 lb)
Included with instrument: Operating manual, power cord, rackmount brackets, programming card.

Ordering Information

Model

Model	January 1989 prices
PM 5192M Programmable Synthesizer/Function Generator	$4000
PM 5192SM Programmable Synthesizer/Function Generator with 10 MHz Reference Input	4295

Option

Rear Panel Output	Consult factory

Accessories (Also see page 485)

PM 9581/01 50Ω Feed-Through Termination 3W	65
PM 9585/01 50Ω Feed-Through Termination 1W	30
System 21 Modular GPIB Switching System	See page 380
PM 2122/01 50Ω Coaxial Switch	680
PM 2230 Series Instrument Driver Software	575
PM 2240/001 TestTeam Software	600
PM 2295/05 IEEE Cable 0.5m	150
PM 2295/10 IEEE Cable 1m	155
PM 2295/20 IEEE Cable 2m	170
PM 2296/50 IEEE-488 to IEC-625 Adapter	70
PM 2296/60 IEC-625 to IEEE-488 Adapter	80
PM 9051 BNC to 4 mm Banana Adapter	9

Service & Support

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5191

GPIB
IEEE-488

PM 5191

PM 5191 2 MHz Synthesizer/Function Generator

- Five standard waveforms: sine, square, triangle and pos./neg. sawtooth
- Crystal-controlled precision and stability covering 0.1 mHz to 2.147 MHz
- Maximum 30V peak-to-peak output and TTL output
- Completely independent AC and DC settings within the ±15V window
- Full 8-digit resolution with clear LED read-out
- Remote control of all programmable functions via GPIB/IEEE-488 interface
- Internal and external AM modulation

The PM 5191 is a precision frequency source with the assurance of long term stability and reproducibility. A crystal oscillator serves as a reference for the generated frequencies, ensuring the PM 5191 will always continue to provide the selected frequency to a very high standard of accuracy. Distortion is typically a low 0.35% from 1 Hz to 200 kHz. The PM 5191 also offers excellent phase noise of -80 dBc/Hz. Setting error is negligible at <1 x 10^{-6} and the low aging figure of <1 ppm/year makes the PM 5191's accuracy a true reference standard for applications in R & D, production line testing and quality control, and many other fields of engineering. The PM 5191's frequency range extends from 0.1 mHz to 2.147 MHz (actual range depends on selected wave- form). Output voltages are programmable up to 30V pp and can be expressed in Vpp, Vrms or dBm.

Frequency resolution is a full 8 digits, with a maximum resolution of 0.1 mHz allowing full advantage to be taken of PM 5191's very high precision, useful in the identification and measurement of phenomena occuring at precisely defined frequencies.

A choice of five different waveforms covers almost all standard function requirements, with sine, square wave, triangle and sawtooth (positive and negative going). The PM 5191's outstand- ing capabilities and precision are combined with an economic cost, making this instrument an attractive, general purpose tool for a very wide range of different applications.

Auto-Store

All parameters like frequency, amplitude and DC offset are easily and quickly entered using the front-panel keyboard. Also the current setting is stored in non-volatile memory, and can be used again after switching on the instrument.

GPIB/IEEE-488 Compatibility

The PM 5191 has full GPIB/IEEE-488*/IEC-625 bus compatibility. All functions are remotely selec- table via the bus, while settings and status data can be transmitted to a remote controller and recalled whenever required.

In this system mode, large numbers of automatic measurements can be made continuously and with complete reproducibility, for excellence in quality control applications. IEEE-488 addresses are set via the numeric keyboard, and can be displayed on the 3-digit LED display.

Waveform Selection

The waveform keyboard area allows selection of PM 5191's 5 standard waveforms: sine, square wave, triangle and sawtooth (positive and negative going).

All buttons have an LED indicator to show at a glance which function is selected, as well as to provide a warning of functions for which entries are incomplete.

Waveform Output Levels

Key symbol	Waveform	Max. frequency	Output Vpp (open loop)
∿	Sine	2.147 MHz	0...30
⎍	Square	2.147 MHz	0...30
⋀	Triangle	200 kHz	0...30
⟋	Positive sawtooth	20 kHz	0...15
⟍	Negative sawtooth	20 kHz	0...15

Precise Frequency Programming

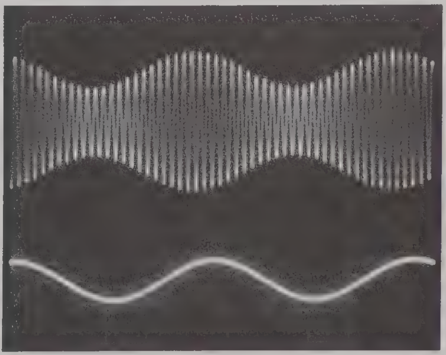
A frequency keypad area allows precise programming of frequency-related settings, choice of dimension (Hz/kHz) and frequency programmable widths for discrete frequency steps. User defined frequency steps can be repeated manually in either direction using the step + or - buttons. Frequency values are programmed via the numeric keyboard, using the ENTER button. The RUB-OUT key on the numeric keypad allows values to be corrected before entry.

Modulation Modes

The PM 5191 has various modulation modes such as AM, FM, burst etc., including AM internal and AM external.

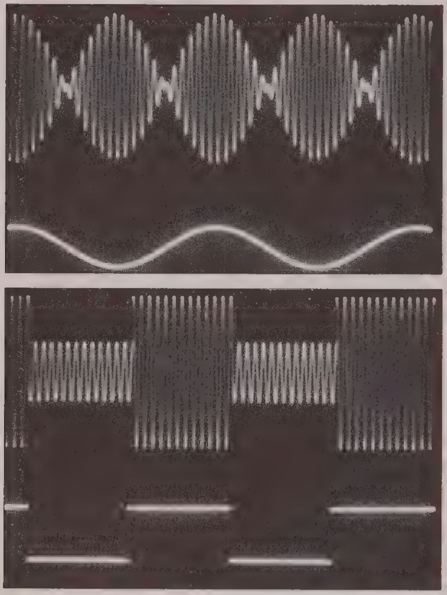
In AM external mode the carrier can be modulated with a frequency between DC and 200 kHz. This DC coupled modulation input allows modulation of the carrier not only with a sinewave but also with a square wave, triangle or superposed sine. With a superposed sinewave (DC = -1.4V) you can generate Amplitude Modulation with suppressed carrier.

The carrier can also be modulated with an external square wave, giving pulse modulation. On-off amplitude ratio is adjusted using the external square wave.



**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog*

PM 5191



Output Level Setting

Selection of output levels in Vpp, Vrms or dBm is by means of the keypad, and the selected output voltage is shown on the 3-digit LED display. The step functions (Δ level) allow quick output-level changes in presettable steps. The nominal maximum outputs are waveform-dependent (see table).

Signal outputs, including TTL output, are short-circuit-proof and located on the front panel.

Specially developed circuitry prevents any interaction between AC and DC settings within a ±30V window. These settings may therefore be independently programmed. A warning is given by a flashing key LED if any combined AC and DC setting exceeds the ±30V window.

IEEE-488 Address Setting

Setting of an IEEE-488 system address can be done locally, via the front panel. With PM 5191, all that is necessary is to activate the 'address' key. The current address is then displayed, and a new address can be programmed if required.

Learn and Identification Modes

Learn and identification modes facilitate programming in system environments. In Learn mode, instruction strings for front panel settings can be up-loaded to a controller for later recall.

In identification mode, PM 5191 responds to controller identification requests with its type number and software version. Rack mounting hardware is supplied, increasing versatility in system environments.

Rear Panel Connection Facilities

A number of additional connection facilities are provided on the rear panel of PM 5191:

Inputs:

Ext. clock: PM 5191SM can lock onto external reference signals (10 MHz) applied to the BNC connector. The PM 5191M can lock onto external reference signal from other PM 5191/2/3 generators (8.6 MHz)

Modulation: External frequencies can modulate the carrier (AM).

Outputs:

Int. clock: The reference frequency of (10 MHz or 8.6 MHz) is available at the int. clock connector. This frequency can be used for synchronization purposes, for example with other generators PM 5193 and/or PM 5192.

Modulation: The signal output from PM 5191's internal modulation frequency source is available at this socket for triggering purposes.

IEEE-488 connector: For direct connection of PM 5191 into IEEE-488 bus-oriented measuring systems. The shielded IEEE-488 connector provides optimal security against disturbance of IEEE data.

Specifications

Technical Specifications

Frequency Characteristics

Nominal Range: 0.1 mHz - 2 MHz
Operational Range: Sinewave 2.147 MHz;
Squarewave 2.147 MHz;
Triangle 200 kHz;
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz
Setting: Local via front-panel keyboard. Remote via IEEE bus interface +/- stepping function with programmable step width
Resolution: 8 digits; <0.1 mHz
Display: 8-digit LED display, Hz/kHz dimension LEDs
Setting Error: <1 x 10^{-6}
Temperature Coefficient: <0.2 p.p.m./K
Aging: <1 p.p.m. per year
Drift: <0.3 p.p.m. in 7h
Phase Jitter RMS: <3 mRAD
Phase Noise: < - 80 dBc/Hz (1 kHz from carrier)

Output Characteristics

Main Output
Connector: BNC socket on front or rear panel
Impedance: Z_o = 50Ω
Load Capability: Short-circuit proof
Max. External Voltage: ±15 Vpp (<3 min.)

AC Voltage
Independent of DC settings within ±15V window
Ranges: I 3.1 - 30 Vpp;
II 0.31 - 3.00V;
III 0 - 0.300V
Resolutions Ranges: I 0.1V;
Range II 0.01V;
Range III 0.001V
Setting: Remote or local +/- stepping
Programmable step width
Basic Setting Error: ±2.5% (1 Hz - 200 kHz) (0.31 - 3.00v)

DC Voltage
Independent of AC setting within ±15V window
Range: +/- 10V open-circuit voltage
Resolution: 0.1V
Error: ±2% of setting ±40 mV
Setting: Remote or local; +/- stepping function.
Programmable step width

TTL Output
Connector: BNC socket on front panel
Fan-Out: <5 TTL inputs
Level: 0/5V

Waveforms

Standard Functions: Sinewave, squarewave, triangle, sawtooth (positive- and negative- going ramps)
Selection: Local via front panel keyboard. Remote via IEEE bus interface
Indication: Key LEDs

Sinewave
Frequency Range: 0.1 mHz...2.147 MHz
Output Range: 0...30 Vpp
Distortion
THD: <0.35% (1 Hz< f <200 kHz, open circuit voltage <10 mVpp)
Harmonics: <-35 dBc (200 kHz< f <2.147 MHz, open circuit voltage ≥10 mVpp)
Spurious: <-40 dBc (0.1 mHz< f <2.147 MHz, open circuit voltage <31 mVpp, distance from carrier <15 kHz)

Squarewave
Frequency Range: 0.1 mHz - 2.147 MHz
Transition Times: <35 ns
Duty Cycle: 50%
Output Range: 0-30 pp
Abberration: <2% ±3 mV range II;
<2% ±20 mV range I

Triangle
Frequency Range: 0.1 mHz - 200 kHz
Output Range: 0 - 30 Vpp
Temperature Coefficient: <0.1%/K
Linearity: <99%
Sawtooth (pos/neg ramps)
Frequency Range: 0.1 mHz - 20 kHz
Output Range: 0 - 15 Vpp
Temperature Coefficient: <0.1%/K
Flyback Time: <1 µs
Linearity: <99%

Modulation

Internal AM
Carrier Frequency: 0.1 mHz - 2 MHz
Modulation Frequency: 1 kHz
Modulation Depth: (30 ±2)%
Modulation Distortion: <0.6% (sinewave modulation)

Modulation Output: 0.3 Veff ±3%
External AM
Modulation Frequency: 0 - 200 kHz
Modulation Distortion: <1.5% (depth <98%) <0.7% (depth <50%)

10 MHz Output (PM 5191S only)
Protection: Short-circuit proof, max. external voltage 10V
Frequency: 10 MHz (squarewave)
Level: Typ. 2 dBm >0 dBM
Impedance: 50Ω

External Reference Input (PM 5191S only)
Maximum Voltage: ±5V
Waveform: sine or square
Frequency: $\frac{10\text{ MHz}}{N}$ N + 1,2,3...10 for synchronization purposes
Lock-In Time: <2s
Lock-In Range: ±0.1% - a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency
Level: 0 - 20 dBM
Impedance: 50Ω

IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics
Interface Functions: AH1, L4, RL1, SR1, SH1, T6
Listener Address: Decimal programmable via keyboard, indicated by LED display
Address Range: 0 - 30
Service Request: Error message
Remote Lock-Out: Go-to local front panel key
Device Identification and learn modes provided as standard

General Specifications

Miscellaneous

Non-Volatile Memory: 1 memory location for current setting
Rear Connectors: Modulation output BNC; Clock output BNC; Modulation input BNC; Clock input BNC; IEEE bus connector; Mains connector

Operating Conditions

Reference Temp.: 23°C ±1°C
Operating Temp.: 5°C...40°C
Storage Temp.: -20°C...+70°C

Power Requirements

Line Voltage: 100, 120, 220, 240V, tolerance ±10%
Line Frequency: 50 - 60 Hz, tolerance ±5%
Power Consumption: 100W

Size: 105 mm H x 440 mm W x 430 mm L. (4.1 in H x 17.3 in W x 16.9 in L)
Rack mounting facility standard (2 units high)
Weight: 10 kg (22 lb)
Included: Operator's manual, line cord, rackmounting ears.

Ordering Information

Model

January 1989 prices

PM 5191M Programmable Synthesizer /function generator	$3395
PM 5191SM Programmable Synthesizer/ function generator with 10 MHz reference input	3695

Option

Rear Panel Output	Consult Factory

Accessories (Also see page 485)

PM 9581/01 50Ω feed-through Termination 3W	65
PM 9585/01 50Ω feed-through Termination 1W	30
System 21 Modular GPIB Switching System	See page 380
PM 2122/01 50Ω Coaxial Switch	$680
PM 2230 Series Instrument Drivers Software	575
PM 2240/001 TestTeam Software	600
PM 2295/05 IEEE Cable 0.5m	150
PM 2295/10 IEEE Cable 1m	155
PM 2295/20 IEEE Cable 2m	170
PM 2296/50 Bus Adapter, GPIB/IEEE to IEC	70
PM 2296/60 Bus Adapter IEC to GPIB/IEEE	80
PM 9051 BNC to 4 mm Banana Adapter	9

Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5190X

GPIB
IEEE-488

PM 5190X

PM 5190X 2 MHz Synthesized Function Generator

- Sine, triangle, square waveforms
- 0.001 Hz...2.147 MHz frequency range
- Max 20 Vp-p output and separate TTL output
- Extremely accurate frequency setting to within ±1 x 10^{-6}
- External AM facility
- Very high short- and long-term stability
- Fast feather-touch parameter selection

This microprocessor-based synthesizer includes many unique features that lift it into a special class of medium-priced signal sources for most professional applications, including instrument calibration. Typical design criteria include ±1 x 10^{-6} frequency setting error and an ageing characteristic of <1.5 x 10^{-6}/year, which clearly underwrites the inherently high accuracy and stability of this instrument.

It will thus be of interest to design or research laboratories seeking such a highly accurate, stable signal source in the range 0.001 Hz to 2.147 MHz for both routine bench use and inclusion in automatic test systems. Its high-grade, virtually zero-error performance, plus simplicity and speed of operation make it equally attractive for use in advanced educational programs.

The output frequency of the crystal controlled oscillator is shown on a bright 6-digit LED display together with the AC (2 digits) and DC (2 digits) outputs. DC polarity is also displayed.

In addition, the preselected waveforms and external amplitude modulation characteristics are indicated on this panel.

The user has a choice of sine, square and triangle waveform outputs which are available from a 50Ω front panel socket (BNC connector).

In addition, there is an adjacent TTL socket. External amplitude modulation signals, from 0...<90% modulation depth can be connected via a rear input socket.

A very clear, simply designed front panel makes operation extremely easy. Fast selection of the desired parameters is assured by 'feather-touch' input push buttons.

Maximum AC output, for all waveforms is 19.9 Vpp. A DC offset voltage of up to 9.9V max., is available for setting this output to the desired DC level, up to 19.9V total amplitude. Voltage levels can be set in minimum increments of 1 mV.

All functions are fully remotely controllable via the built-in IEC-bus interface, enabling the unit to be used within an automatic testing system, if desired, (no modifications or extra accessories are needed). The PM 2296/60 adapter allows the PM 5190X to also be used in GPIB/IEEE-488* systems. This facility is further enhanced by the high switching speeds resulting from a direct digital signal synthesis technique.

All these comprehensive facilities are contained in a very compact, portable package.

Typical applications in an automated system include, for example:

- Accurate testing of audio filters when checking bandpass curves.
- As a standard, when checking servo motor speed control systems or for audio/video tape stress testing, etc.

Also, when employed as a signal source for calibrating instruments (e.g. frequency meters) its highly accurate and stable output signal may be used.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 1 mHz...2.147 MHz
Measuring Range: 1 mHz...2.147 MHz for sine and square wave;
1 mHz...<100 kHz for triangle wave

Setting
Local: Via front panel keyboard
Remote: Via IEC bus interface
Display: 6-digit 7-segment LED display;
6 decimal points;
2 LEDs for dimension Hz, kHz
Setting Error: ±1 x 10^{-6} at 23°C
Temperature Coefficient: <1 x 10^{-6}/K
Ageing: <1.5 x 10^{-6} per year

Waveforms

Sine wave
Square wave
Triangle wave
All time-symmetrical
All with or without DC offset
DC voltage without AC

Selection
Local: Via front panel keyboard
Remote: Via IEC bus interface
Indication: LEDs for the selected waveforms

Sine Wave

Total Harmonic Distortion: <0.4% (1 mHz... 50 kHz);
<1.5% (50 kHz...2.147 MHz)
Non-Harmonic Components at Max. Amplitude: <-46 dB
Phase Noise: <-50 dB within 30 kHz bands, centered to the output frequency; (frequencies <50 kHz)

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Square Wave

Rise Time, Fall Time: <50 ns
Duty Cycle: 50%
Tilt: <3% (f <100 kHz)
Overshoot: <3%
Duty Cycle: 50%
Tolerance: <0.5% (f + 1 kHz)

Triangle Wave

Frequency Range: 1 mHz...<100 kHz
Linearity: <99% for frequencies <10 kHz

Modulation

Mode: Amplitude modulation, external
Indication: LED
Carrier: Sinusoidal and triangular waveform frequency <10 Hz
Modulation Frequency: DC...20 kHz
Modulation Coefficient: 0.1V per 10% AM
Modulation Depth: 0...90%
Connector: BNC socket AM EXT (rear side)
Input Impedance: 20 kΩ
Max. External Voltage: ±30V
Reference Potential: External contact of BNC socket

Output Characteristics

Connector: BNC socket (front side)
Impedance: 50Ω ±2%
Short-Circuit Proof: Yes
Max. External Voltage: ±15V
Reference Potential: External contact of BNC socket

AC Voltage

Range: 19.9 VACp-p open circuit
Sub-Ranges:
I .000...0.199 VAC
II 0.00...1.99 VAC
III 00.0...19.9 VAC
Setting
Local: Via front panel keyboard
Remote: Via IEC bus interface
Display: 2 digit, 7-segment LED
Setting Error: 3% for settings 2.0V <AC <19.9V for frequencies <100 kHz
Temperature Coefficient: 0.1%/K

DC Offset Voltage

Range: 0...9.9 VDC
Sub-Ranges:
I .000...0.099 VDC
II 0.00...0.99 VDC
III 00.0...09.9 VDC
Sub-Range Selection: Determined by subrange setting
Mimimum Increments:
1 mV in sub-range I
10 mV in sub-range II
100 mV in sub-range III
Polarity: Positive or negative selectable via keyboard
Setting
Local: Via front panel keyboard
Remote: Via IEC bus interface
Display: 2-digit, 7-segment LED, decimal point, position determined by AC decimal point setting
Setting Error: 4% (10%...100% of each subrange)
Temperature Coefficient: <0.1%/K (10%... 100% of each subrange)
Max. DC Voltage Setting: Depending on AC voltage setting: DC indication 1100 - (AC indication)/2; decimal points ignored

TTL Output

Connector: BNC socket TTL OUT
Duty Cycle: 50%
Fan Out: ≥10
Level: Standard TTL-level

Out-of-Range Indication

Display flashes if,
- frequency setting <2147 kHz
- frequency setting >100 kHz for triangle
- frequency resolution <1 mHz
- DC voltage exceeds in max AC voltage setting

Remote Control

Conformity: IEC-625: interface system of programmable measuring apparatus
Interface: Built-in IEC bus interface
Remote State Indication: Front panel LED
Programmable Parameters:
- frequency
- AC voltage
- DC voltage
- wave form

Response Time:
- 4 ms for waveform
- 10 ms for AC voltage
- 7 ms for frequency
- 12 ms for DC voltage

IEEE/IEC Interface Data
An IEC-625 interface is supplied, being built into the instrument, with rear access
Connector: 25-pole IEC standard connector
Interface Functions:

AH1	Acceptor handshake
L2	No additional functions possible
RL2	Remote/local total capability

Code: ISO 7-bit code
Connector: 25-pole standard interface connector (rear side)
Max. External Voltage: -0.5...+5.5V, standard TTL level
Reference Potential: Measuring earth
Connector Housing: Connected to protective conductor

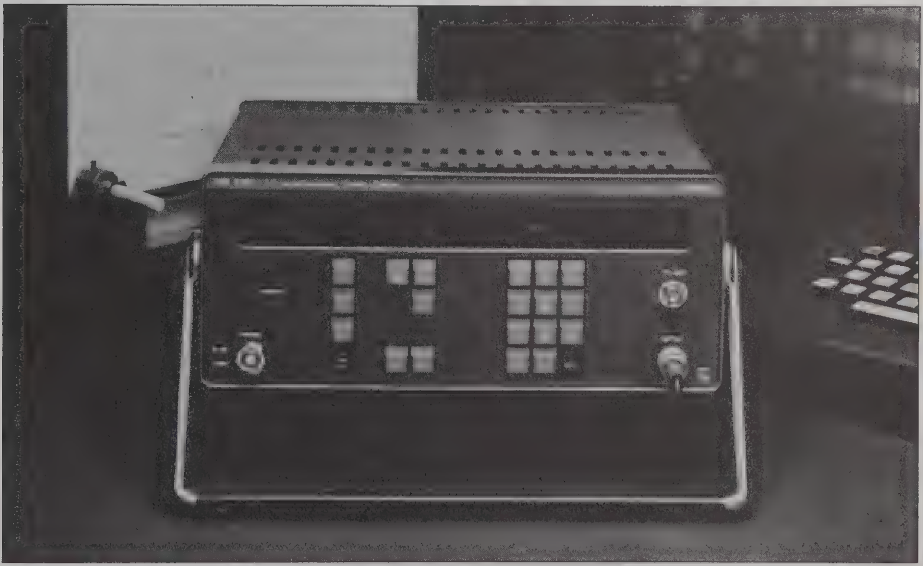
General Specifications

Power Requirements

Voltage: 110, 120, 220, 238V ±10%
Power Consumption: 47W
Frequency: 50/60 Hz

Operating Conditions

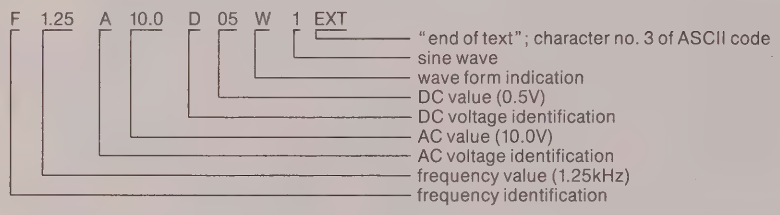
Reference Value: +23°C ±1°C
Nominal Range: +5°C...+40°C
Limits for Storage and Transportation: -40°C...+70°C
Size: 310 mm W x 140 mm H x 365 mm L (12.5 in W x 5.5 in H x 14.5 in L)
Weight: 6 kg (13.2 lb)
Included with instrument: Instruction manual, attached line cord



Automatic measuring and plotting of frequency response is made easier using the PM 5190X.

PM 5190X

PROGRAMMING EXAMPLE


F 1.25 A 10.0 D 05 W 1 EXT
"end of text"; character no. 3 of ASCII code
sine wave
wave form indication
DC value (0.5V)
DC voltage identification
AC value (10.0V)
AC voltage identification
frequency value (1.25kHz)
frequency identification

Ordering Information

Model

PM 5190XM 2 MHz Synthesizer	$2600

Accessories (Also see page 485)

PM 9075 Coaxial Cable BNC BNC	11
PM 9560 19-in Rackmount Adapter	130
PM 2122/01 50Ω Coaxial Switch	680
PM 2240/001 TestTeam Software	925
PM 2296/60 IEC-625/IEEE-488 Adapter	80
System 21 Modular GPIB Switching System	See pg 380

Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491

PM 5134

PM 5134

PM 5134 20 MHz Function/Sweep Generator

- Sine, square, triangle, pulse
- 0.001 Hz...20 MHz frequency range in 7 sub-ranges
- 20 Vp-p output and separate TTL output
- Normal or high accuracy crystal controlled operation
- Internal or external sweep and AM/FM modulation facilities
- Burst and single-cycle with variable start phase
- Stepped and variable attenuation over 60 dB range

The PM 5134 is an easy-to-use, yet extremely sophisticated function generator embodying an unusually wide range of facilities in a single instrument.

It will produce sine, square and triangle waveforms as well as positive and negative pulses and DC. The duty cycle is variable between 10% and 90%.

The wide, 1 mHz to 20 MHz frequency range is divided into 10 sub-ranges, which are selected by means of a rotary switch with an overriding coarse/fine adjustment. This fine adjustment, combined with the 3-digit LED display, gives an immediate, highly accurate readout of the selected frequency. Setting-up procedures are thus very much simplified compared with the traditional dial setting and any human errors (e.g. parallax) are eliminated.

In addition, the 3-digit display can be used to monitor the open-circuit output voltage by depressing a push-button. Also, when used in the sweep mode, the start, stop and run frequencies are indicated by separate LEDs. Moreover, an error warning lamp automatically indicates any incompatible set-up conditions.

The high, nominal accuracy (see technical specification) of ±2% ±1 digit, can be further improved to ±5 x 10^{-6} by operating the instrument in the crystal-controlled mode. This facility is useful, for example, for identical repetitive measurements requiring high accuracy, or for narrow band filter tests. The crystal AM mode offers a stable carrier wave. One particular application is when using a 10.7 MHz carrier frequency to check that the discriminator section of a radio receiver is suppressing the AM waveform.

The continuously variable 20 Vp-p max. output (10 Vp-p pulses) is available at the front-panel mounted socket; there is a push-button choice of 600Ω or 50Ω output impedance. Output attenuation is selectable in any combination of 3-6-10-20 dB push-buttons with an overriding continuous 20 dB control. Sweep facilities include single and continuous operation. The single sweep can be triggered either manually, or electronically from an external source. The sweep period is continuously adjustable between 5 ms and 100s. The START and STOP frequencies are non-interactive and can be set independently of each other. A HOLD facility allows a sweep to be stopped at any desired frequency useful for checking phenomena occurring during a sweep by means of a push-button. An interrupted sweep is continued by simply releasing the HOLD button. If required a sweep can be reset to the start frequency using the RESET push-button.

The generator offers an internally or externally controlled burst or single-cycle signal. The start/stop phase is continuously adjustable between -90° and +90°.

The internal AM is adjustable between 0 and 100% modulation depth. The modulation frequency can be set over a wide range from 10 mHz to 20 kHz. The AM facility can be used with crystal control, if desired. External AM inputs in the range from DC to 20 kHz can be applied via a rear-mounted BNC-socket.

The internal FM can be adjusted, continuously, between zero and ±10% frequency deviation.

Other input/output facilities available on the rear panel include a TTL output and pen-lift control.

The well-considered design of the PM 5134 has resulted in a clean, simple front panel layout which allows the operator to become familiar with all control functions very quickly. Its overall versatility makes it suitable for a very wide range of applications within research design or educational organizations. The instrument occupies minimal bench space and is short-circuit proof.

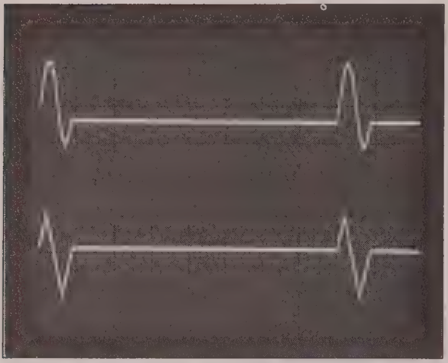
Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 1 mHz...20 MHz
Display: 3 digits; 7-segment LED;
4-dimension LEDs mHz, Hz, kHz, MHz.
Setting Error: ±2% ±1 digit (1 mHz...2 MHz)
±5% ±1 digit (2 MHz...20 MHz)
Temperature Coefficient: <1.0 x 10^{-3}/K (20 MHz range excluded)
Short Term Drift: (<15 min)
<1 x 10^{-3} (1 mHz...2 MHz)
<4 x 10^{-3} (2 MHz...20 MHz)
Long Term Drift: (<7h); <3 x 10^{-3}
Duty Cycle: 50% fixed
<10%...>90% continuously variable (20 MHz range excluded)

PM 5134



Repetitive single sine wave and triangle shown with different start phase

Waveforms: Sine wave, square wave, triangular wave, positive pulse, negative pulse (with or without DC offset), DC voltage without AC

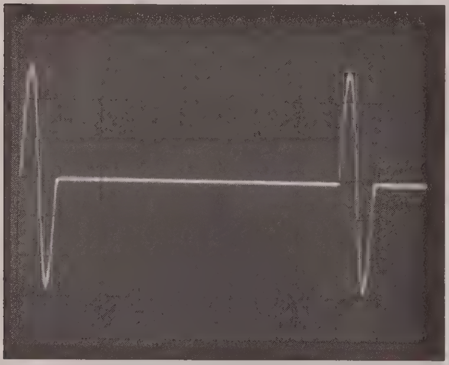
Output

AC Voltage

Max. Open Circuit Voltage: 20 Vp-p (10 Vp-p for pulse)

Indication Open Circuit Output Voltage: Alt. mode frequency display

Attenuation: 3, 6, 10, 20 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable



Repetitive single sine wave signal

Impedance: 50Ω or 600Ω selectable

Short-Circuit Proof: Yes

DC Voltage

Offset Voltage: -5V...+5V (open circuit)

Sine Wave

Total Harmonic Distortion: <0.5% (1 Hz...200 kHz); <3% (1 mHz...2 MHz)

All harmonics more than 26 dB below fundamental (1 MHz...20 MHz)

Frequency Response of Amplitude: <0.1 dB (0.1 Hz...200 kHz);
<0.5 dB (1 mHz...2 MHz);
<1.5 dB (1 MHz...20 MHz, for max. amplitude)

Triangle Wave

Linearity: <99% (<100 kHz)

Square Wave

Rise and Fall Time:<18ns

Overshoot and Ringing: <3%

Positive/Negative Pulses

See Square Wave

TTL

Duty Cycle: As main output

Fan Out: <5

Pen Lift

Internal Modulation

Sweep Facilities

Internal Sweep

Characteristics: Linear

Max. Sweep Range: 2 decades

Mode: Single or continuous

Indication: $3^{1}/_{2}$ digits, 7-segment LED, 3 LEDs STOP, RUN and START

Period Time: 5 ms...100s Continuously adjustable in 4 sub-ranges

Control Functions: HOLD, RESET, TRIG (manually) and electronic triggering

Frequency Control Voltage at Modulation Output: 0...5V (f start...f stop)

External Sweep/FM

Input: SWEEP/FM

Characteristics: Linear

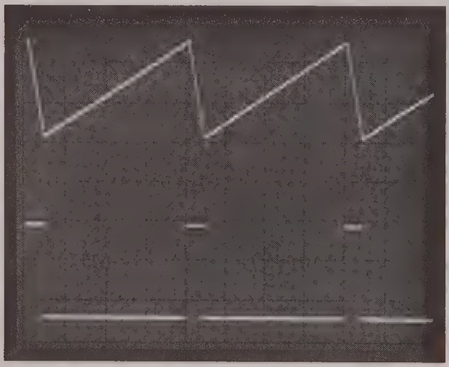
Voltage/Frequency Characteristic: 1V/0.2 max. frequency

Max. Sweep Range: >$2^{1}/_{2}$ decades for sub-ranges above 2 Hz

Input Resistance: 5kΩ

Max. Sweep Rate:>200 Hz ($1^{1}/_{2}$ decades range)

Sweep Voltage: Sawtooth, duty cycle 90%



Variable duty cycle shown in triangular and square wave signals

Burst Facilities

Internal Burst

Continuous Operation

On/off Ratio: Approx. 1:1 (last cycle ends at START-PHASE level)

Repetition Time: 0.05 ms...100s Continuously adjustable in 6 sub-ranges

Single Operation

Duration: See Continuous Operation, Repetition time

Triggering: Manually or electronically via TRIG & BURST input

Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable

External Burst

Input: TRIG & BURST

Control Voltage: TTL-level

Start: Low/High-transition

Stop: High/Low-transition.(when output signal reaches START-PHASE)

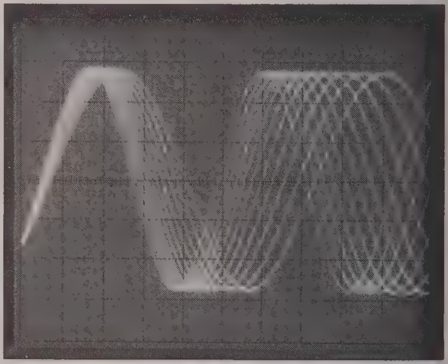
Max. Control Frequency: 2 MHz

Start Phase: -90°...+90°(-π/2...+π/2), continuously adjustable

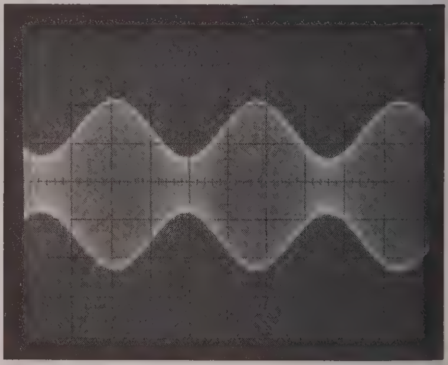
Single Facilities

Internal Single Continuous Operation

Repetition Time: 0.05 ms...100s continuously adjustable



Frequency sweep or frequency modulation



Carrier wave with AM modulation

Single Operation

Triggering: Manually or electronically via TRIG & BURST input

Start Phase:-90°...+90° (-π/2...+π/2), continuously adjustable

External Single

Input: TRIG & BURST

Modulation

Internal FM
Modulation Waveform: Sine wave
Deviation: Approx. 0%...10%
Continuously adjustable
Modulation Frequency: 0.01 Hz...20 kHz
Continuously adjustable in 6 sub-ranges
Modulation Voltage: Available at modulation output

External FM
Input: SWEEP/FM

Internal AM
Modulation Waveform: Sine wave
Modulation Depth: 0...<100%
Continuously adjustable
Modulation Frequency: See internal FM
Modulation Voltage: See internal FM

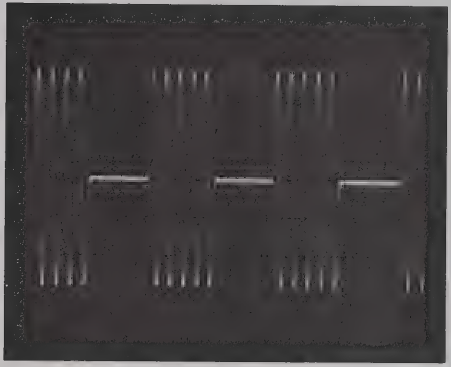
External AM
Input: AM
Modulation Waveform: Arbitrary with spectral components up to 20 kHz
Modulation Depth: 0...<100%
Continuously adjustable

Crystal Mode

Frequency Lock: Freezes the momentary frequency display (frequency setting inhibited)
Accuracy: ±5 x 10^{-6}

Crystal AM Mode

See X-tal mode with additional facilities of internal and external AM



Burst signal

General Specifications

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Power Consumption: 55 W
Frequency: 50/60 Hz

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -40°C...+70°C
Size: (wxhxd) 310 mm W x 140 mm H x 390 mm L (12.2 in W x 5.15 in H x 15.4 in L)
Weight: 6.5 kg (14.3 lb)
Included with instrument: Instruction manual, attached line cord

Ordering Information

Model

January 1989 prices

PM 5134M Function Generator	$2600

Accessories (Also see page 485)

PM 9075 Coaxial Cable BNC	11
PM 9581/01 50Ω/3W Termination	65
PM 9051 Adapter BNC/4mm	9
PM 9560 19-in Rackmount Adapter	130

Service & Support

Warranty

One-year product warranty. See Page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5133

PM 5133

PM 5133 2 MHz Function/Sweep Generator

- Sine, square, and triangular waveforms, pos./neg. pulses, DC
- 0.01 Hz...2 MHz frequency range in 7 sub-ranges
- 20 Vp-p output
- Logarithmic or linear sweep with manual and electronic sweep trigger
- Internal or external sweep facility
- Single and burst with variable start phase
- Frequency and open circuit output voltage indicated on 3-digit LED display

The versatile PM 5133 function generator offers both linear and logarithmic sweep facilities in addition to a wide range of other features. Outputs include sine, triangle and square waveforms as well as positive or negative pulses, and DC, The duty cycle is variable between 10% and 90%.

The wide frequency range of 10 MHz to 2 MHz is selected by means of a 7-position rotary switch with an overriding coarse/fine adjustment. A high-precision, electronic system, using a 3-digit LED provides very accurate, clearly readable setting conditions and eliminates those human errors (e.g. parallax) likely to occur with more conventional mechanical dials. The display is also used to monitor the open-circuit output voltage, sweep limit values and incompatible set-up conditions.

The output voltage (20 Vp-p max., except for pulses at 10 Vp-p max.) is available at the front-panel mounted socket; there is a push-button choice of 50Ω or 600Ω output impedance. Output attenuation of more than 80 dB is selectable in any combination of calibrated steps of 3-10-20-30 dB with an overriding 20 dB continuous control. The output voltage level can be checked by simply depressing a push- button, and can be read on the LED display.

Linear or Logarithmic Sub-Ranges

Sweep facilities include single-shot and continuous operation, with the choice of linear or logarithmic mode. Frequency ranges are divided into either seven linear or five logarithmic sub-ranges with continuous coarse and fine adjustment. The logarithmic sweep ranges cover more than four decades, making the instrument extremely useful for sweeping within the audio range.

The single sweep can be triggered either manually, or electronically, from an external source. The sweep period is continuously adjustable between 5 ms and 100s. The START and STOP frequencies are non-interactive and can be set independently of each other. Also, a HOLD facility allows a sweep to be stopped at any desired frequency - useful for checking phenomena which may appear during a sweep - by means of a push-button.

An interrupted sweep is re-started by simply releasing the HOLD button. Again, if required, a sweep can be reset back to the start frequency using the RESET button. When used in the sweep mode, the start, stop and run frequencies are all indicated clearly on separate LEDs.

An error warning LED automatically flashes in the event of any incompatible setting made by the operator.

The generator also offers an internally or externally controlled burst, or single waveform signal, having a continuously adjustable start/stop phase, -90° and +90°.

Other input/output facilities available at the rear panel include a TTL output and pen-lift control, internal modulation voltage and frequency control voltage.

In addition, the PM 5133S version, described on page 282, adds specific features for audio test.

The PM 5133 is designed for maximum electrical and mechanical protection. Careful attention has been given to ergonomic considerations, making the instrument easy to use. Its overall versatility makes it suitable for use within a wide range of applications such as research, design, education and manufacturing. It occupies minimal bench space and is short-circuit proof.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 10 mHz...2 MHz
Display: 3 digits, 7-segment LED, 4 dimension LEDs mHz, Hz, kHz, MHz.
Setting Error:
±2% ±1 digit (10 mHz...200 kHz)
±3% ±1 digit (200 kHz...2 MHz)
Temperature Coefficient:
<1.0 x 10^{-3}/K (linear mode)
<2.5 x 10^{-3}/K (log mode)
Short Term Drift: (<15 min)
<1 x 10^{-3} (10 mHz...20 kHz)
<3 x 10^{-3} (20 kHz...2 MHz)
Long Term Drift: (<7h)
<3 x 10^{-4}

Duty Cycle: 50% fixed
<10%...<90% continuously variable

Waveforms

Sine wave
Square wave
Triangular wave
Positive pulse
Negative pulse
} with or without DC offset
DC voltage without AC

Output

AC Voltage
Max. Open Circuit Voltage: 20 Vp-p (10 Vp-p for pulse)
Indication (EMF): Alt. mode frequency display
Attenuation: 3, 10, 20, 30 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable
Impedance: 50Ω or 600Ω selectable
Short-Circuit Proof: Yes

DC Voltage
Offset Voltage: 0...±5V (open circuit)

Sine Wave
Total Harmonic Distortion:
<0.5% (10 mHz...200 kHz)
<2% (200 kHz...2 MHz)
Frequency Response of Amplitude:
<0.1 dB (10 mHz...20 kHz)
<0.3 dB (20 kHz...1 MHz)
<1.0 dB (1 MHz...2 MHz) (Max. amplitude)

Triangle Wave
Linearity: <99% (10 mHz...100 kHz)

Square Wave
Rise and Fall Time: <60 ns
Overshoot and Ringing: <2% (max. amplitude into 50Ω)

Positive/Negative Pulses
See SQUARE WAVE

TTL
Duty Cycle: As main output
Fan Out: <20

Pen Lift

Internal Modulation

Frequency Control Voltage

Sweep Facilities

Internal Sweep
Characteristics: Linear or logarithmic
Max. Sweep Range: 2 decades (linear mode) 4 decades (log mode)
Mode: Single or continuous
Indication: 3 digits, 7-segment LED, 3 LEDS STOP, RUN and START
Period Time: 5 ms...100s
Continuously adjustable in 4 sub-ranges
Control Functions: HOLD, RESET, TRIG (manually and electronically)
Internal Modulation Output:
0V start frequency;
5V stop frequency
Frequency Control Voltage Output: 0...5V (depending on start- and stop-frequency)
External Sweep/FM
Input: SWEEP/FM
Characteristic: Linear or logarithmic
Linear Characteristic: 1V/0.2 max. freq.
Logarithmic Characteristic: 1V/freq. decade
Max. Sweep Range:
<2 decades (linear mode)
<4 decades (log mode)
Input Resistance: 5 kΩ
Max. Sweep Rate: <4 kHz (1 decade range)
Sweep Voltage: Sawtooth, duty cycle 90%

Burst Facilities

Internal Burst
Continuous Operation
On/Off-Ratio: Approx. 1:1 (last cycle ends at START-PHASE level)
Repetition Time: 5 ms...100s
Continuously adjustable in 4 sub-ranges
Single Operation
Repetition Time: See INTERNAL BURST
Triggering: Manually or electronically via TRIG & BURST input
Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable
External Burst
Input: TRIG & BURST
Control Voltage: TTL-level
Start: Low/high-transition
Stop: High/low transition. (when output signal reaches start phase)
Max. Control Frequency: 2 MHz
Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable

Single Facilities

Internal Single
Repetitive Mode: Same as INTERNAL BURST
Single Triggering: Same as INTERNAL BURST
Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable
External Single
Input: TRIG & BURST
ERROR INDICATION

General Specifications

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Power Consumption: 38W
Frequency: 50/60 Hz

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -40°C...+70°C

Size: 310 mm W x 140 mm H x 390 mm L (12.2 in W x 5.5 in H x 15.4 in L)
Weight: 5.8 kg (14.3 lb)

Included with instrument: Instruction manual, attached line cord

Ordering Information

Model	January 1989 prices
PM 5133M Function Generator	$1950

Accessories (Also see page 485)

PM 9075 Coaxial Cable BNC	11
PM 9581/01 50Ω/3W Termination	65
PM 9051 Adapter BNC/4 mm	9
PM 9560 19-in Rackmount Adapter	130

Service & Support

Warranty
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5133S

PM 5133S

PM 5133S 2 MHz Function/Sweep Generator

- All PM 5133 features plus:
- Specially adapted for Hi-Fi testing according to DIN standard 45 541
- Fixed 50s sweep, 20 Hz...20 kHz selectable
- Sweep started manually or by 1 kHz burst signal
- 26 dB attenuation facility included

The PM 5133S is an enhanced version of the PM 5133, with extra features specifically included to permit the testing of Hi-Fi equipment to DIN standards.

Used in conjunction with an X-Y recorder, it permits the frequency characteristics of, for example, record players, cassette and tape recorders, to be plotted. This instrument has wide-ranging applications in R&D and quality control. It is also ideal for use by audio service workshops — permitting them to show customers whether their equipment is performing according to specification.

The PM 5133S includes all the facilities of the standard PM 5133, plus a single sweep with fixed 50s duration. Start and stop frequencies should be set at respectively 20 Hz and 20 kHz.

The sweep is preceded by a 1 kHz burst lasting 6 seconds when manually triggered. A similar signal fed in via the TRIG and BURST input will automatically start the generator sweep (without burst), as an alternative to manual start.

With this feature it is possible to start a sweep on a record, cassette or tape (provided this is preceded by the burst) synchronously with the sweep of the generator.

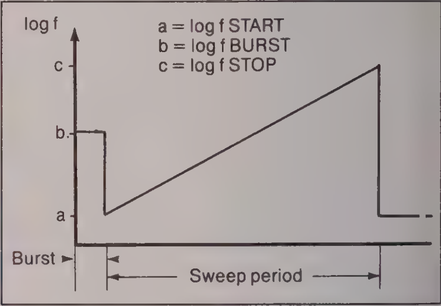
The special sweep is selected by means of the MOD SWEEP PERIOD switch (position 100s) and the PERIOD adjustment (fixed position) with the generator in the logarithmic sweep mode.

Specifications

(Additional to technical specification of PM 5133 for the special sweep).

Output

Attenuation - Fixed: 0, 6, 10, 20, 30 dB, selectabel in any combination
Sweep, Internal: 50s sweep
Mode: Single sweep with fixed period and 1 kHz burst, started by push-button TRIG;
Single sweep with fixed period, electronically started by an external 1 kHz burst applied at input TRIG & BURST
Characteristic: Logarithmic
Start Frequency: 20 Hz set by means of potentiometer START FREQUENCY
Stop Frequency: 20 kHz set by means of potentiometer STOP FREQUENCY
Burst Frequency: 1 kHz (depending on the setting of the start frequency)
Burst Period: 6s
Sweep Period: 50s ±0.2s when:
SWEEP PERIOD in pos. 100 (S);
PERIOD in fixed pos. "S"
Trigger Signal: 1 kHz ±100 Hz
Trigger Sensitivity: 0.5 Vrms
Reset Trigger: By a 1 kHz burst possible after 40s sweep period
a = log f START
b = log f BURST
c = log f STOP
Included with instrument: Instruction manual, attached power cable.



Ordering Information

Model	January 1989 prices
PM 5133SM Function Generator 0.1 Hz - 2 MHz	$2100

Accessories (Also see page 485)

PM 9075 Coaxial Cable BNC	11
PM 9581/01 50Ω/3W Termination	65
PM 9051 Adapter BNC/4 mm	9
PM 9560 19-in Rackmount Adapter	130

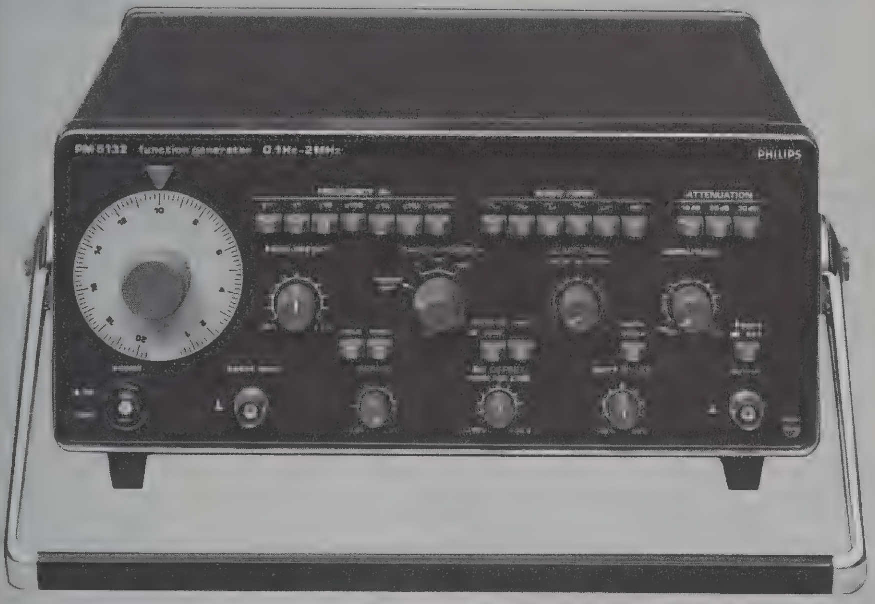
Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5132



PM 5132

PM 5132 2 MHz Function Generator

- Sine, square, triangular waveforms, positive- and negative-going pulses plus DC
- 0.1 Hz...2 MHz in 7 overlapping sub-ranges
- Output: 30 Vp-p (sine, triangle, square); (15 Vp-p for pulses)
- Stepped and variable attenuation over 80 dB range
- Variable DC-offset
- Internal and external sweep facility
- Variable duty cycle

The PM 5132 function generator is a general-purpose instrument that will be very attractive for educational applications as well as for laboratory use. It is an extremely versatile generator which produces sine, triangle and square waveforms plus positive and negative pulses, plus DC. It exhibits a high, 30 Vp-p output for all waveforms and 15 Vp-p for pulses. Output impedance is switchable with a choice of 50Ω or 600Ω.

The duty cycle for all waveforms is variable between 10% and 90% and DC-offset can be selected independently for any waveform. This is adjustable from -10V to +10V.

The frequency range of 0.1 Hz to 2 MHz is adjustable through 7 overlapping subranges and the vernier control allows dial settings of ±2% of the maximum subrange frequency setting.

Sweep facilities are varied and include:

- Choice of linear single or continuous sweep
- Adjustable start frequency in the selected sub-range which is independent of stop frequency
- Maximum linear sweep range of 2 decades
- Sweep period setting between 50 ms and 100s
- Control functions with HOLD or RESET by push-button
- Electronic triggering

A pen-lift output is provided and the instrument is short-circuit proof.

Good ergonomic design makes the operation simple while the instrument occupies minimal bench space.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 0.1 Hz...2 MHz
Indication: Linear dial
Setting Error: ±2%...±0.2% of max subrange frequencies
Vernier Frequency Adjustment: -5%...+5% of frequency setting
Temperature Coefficient: <0.15%/K
Short Term Drift: <0.1%, f <200 kHz (<15 min)
Long Term Drift: <0.25%, f <200 kHz (<7h)
Duty Cycle: 50% fixed
<10%...<90% continuously adjustable

Waveforms

Sine wave
Square wave
Triangular wave
Positive pulse
Negative pulse
DC voltage without AC
} with or without DC-offset

Outputs

AC Voltage
Max. Open Circuit Voltage: 30 Vp-p (15 Vp-p for pulse)
Attenuation: 10, 20, 30 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable
Impedance: 50Ω or 600Ω selectable
Short-circuit proof: Yes

DC Voltage
Offset Voltage: -10...+10V (open circuit)

Sine Wave

Total Harmonic Distortion
<0.5% (0.1 Hz...20 kHz)
<1.0% (20 kHz...200 kHz)
<3.0% (200 kHz...2 MHz)
Frequency Response of Amplitude:
<0.1 dB (0.1 Hz...20 kHz)
<0.3 dB (0.1 Hz...1 MHz)
<1.0 dB (0.1 Hz...2 MHz)
Linearity: <99% (0.1 Hz...100 kHz)

Square Wave

Rise and Fall Time: <75 ns
Overshoot and Ringing: <2%

TTL

Duty Cycle: As main output
Fan Out: <20

PM 5132

Pen Lift

Sweep Output

Internal Sweep

Characteristics: Linear
Max. Sweep Range: 2 decades
Mode: Single or continuous
Period Time: 50 ms...100s
Continuously adjustable in 3 subranges
Control Functions: HOLD, RESET, TRIG (manually and electronically)
Frequency Control Voltage: 0...5V (depending on start- and stop-frequency)

External Sweep

Input: SWEEP TRIG
Characteristic: Linear
Max. Sweep Range: 2 decades
Input Resistance: 47 kΩ
Max. Sweep Frequency: 15 kHz approx.
Sensitivity: 5V for maximum range

General Specifications

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Power Consumption: 25W
Frequency: 50...100 Hz

Operating Conditions

Reference Value: +23°C +1°C
Nominal Operating Range: +5°C...+40°C
Limits for Storage and Transportation: -40°C...+70°C
Dimensions: 310 mm W x 140 mm H x 330 mm L (12.6 in W x 5.5 in H x 13 in L)
Weight: 5 kg (11 lb)

Included with instrument: Instruction manual, attached line cord

Ordering Information

Model

January 1989 prices

PM 5132M Function Generator	$1050

Accessories (Also see page 485)

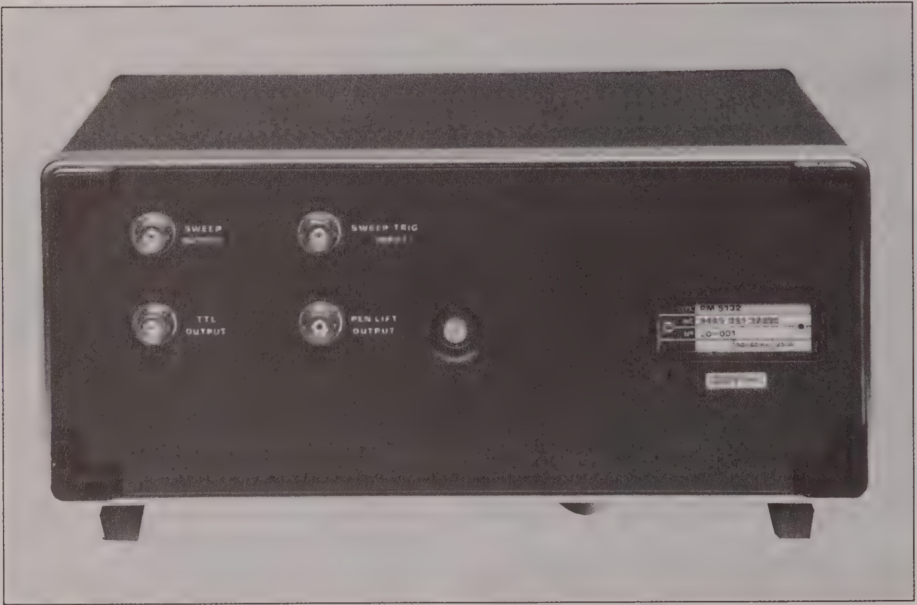
PM 9075 Cable BNC-BNC	11
PM 9560 19-in Rackmount Adapter	130

Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.



Rear view of PM 5132 showing location of sweep, TTL and pen lift outputs and the sweep trigger input.

PM 5131

PM 5131

PM 5131 2 MHz Function Generator

- Sine, square, triangular waveforms
- 0.1 Hz...2 MHz frequency range/in 3 logarithmic sub-ranges
- Max. 30 Vp-p output and separate TTL output
- Stepped & variable output attenuation over 80 dB range
- Logarithmical sub-ranges
- Variable DC offset
- Internal & external sweep facility

The PM 5131 function generator is an instrument designed for applications extending from educational to the broad general purpose area. its many features make it an extremely versatile nstrument for a modest price. Among these eatures are the high, 30 Vp-p output voltage and he facilities for both internal and external sweep. This latter feature covers the audio frequency ange in a single shot. The frequency is adjustable in three logarithmical sub-ranges from 0.1 Hz to 2 MHz. The frequency vernier allows the requency setting to be varied from -20% to +20%. The maximum output voltage is 30 Vp-p open circuit) on the main output having a 50Ω mpedance. The attenuation can be set over a vide range, either in calibrated steps of 10 dB to a maximum of 60 dB or in combination with the 0 dB continuous attenuator.

A sine, triangle or square wave signal is selected by simply pressing the appropriate push-button. DC voltage can be selected separately without any waveform or whenever used as DC offset can be varied between -10V and +10V.

PM 5131 also provides a 3¹/₃ decade internal sweeping facility with adjustable sweep range and a variable sweep period from 10 to 150 seconds.

This is especially useful when sweeping in the audio range to cover the frequency range of 20 Hz...20 kHz in a single sweep. Added to the versatility of this instrument are an external sweep facility and a TTL output. Good ergonomic design makes operation simple while the instrument occupies minimal bench space.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 0.1 Hz...2 MHz
Indication: Logarithmic dial
Setting Error: ±10%
Vernier Frequency Adjustment: -20...+20% of frequency setting
Temperature Coefficient: <0.5%/K
Short Term Drift: (<15 min) <1.5%
Long Term Drift: (<7h) <3%

Waveforms

Sine wave
Square wave
Triangular wave
DC voltage without AC
} with or without DC offset

Output

AC Voltage
Max. Open Circuit Voltage: 30 Vp-p
Attenuation: 10, 20, 30 dB calibrated steps selectable in any conbination plus 20 dB continuously adjustable
Impedance: 50Ω
Short-Circuit Proof: Yes

DC Voltage
Offset Voltage: -10...+10V (open circuit)

Sine Wave

Total Harmonic Distortion:
<0.5% (0.1 Hz...20 kHz)
<3.0% (0.1 Hz...2 MHz)
Frequency Response of Amplitude:
<0.1 dB (0.1 Hz...20 kHz)
<0.3 dB (1 kHz...1 MHz)
<1.0 dB (1 kHz...2 MHz)

Triangle Wave

Linearity: <99%

Square Wave

Rise and Fall Time: <75 ns
Overshoot and Ringing: <2%

TTL

Duty Cycle: 50%
Fan Out: <20

Internal Sweep

Characteristics: Logarithmic
Max. Sweep Range: 3¹/₃ decade
Mode: Single
Period Time: <10...150s
Continuously adjustable
Frequency Analog Voltage: 1V/frequency decade

External Sweep

Input: SWP voltage
Characteristic: Logarithmic
Max. Sweep Range: $3^{1}/_{3}$ decade
Input Resistance: 1 kΩ
Max. Sweep Frequency: Approx. 5 kHz
Sensitivity: 1V/frequency decade

General Specifications

Power Requirements

Voltage: 115, 230V ±15%
Power Consumption: 21W
Frequency: 50...100 Hz

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -4°C...+70°C
Size: 310 mm W x 140 mm H x 330 mm L (12.6 in W x 5.5 in H x 13 in L)
Weight: 4.5 kg (10 lb)
Included: Instruction manual, attached line cord.

Ordering Information

Model	January 1989 prices
PM 5131M Function Generator	$725

Accessories (Also see page 485)

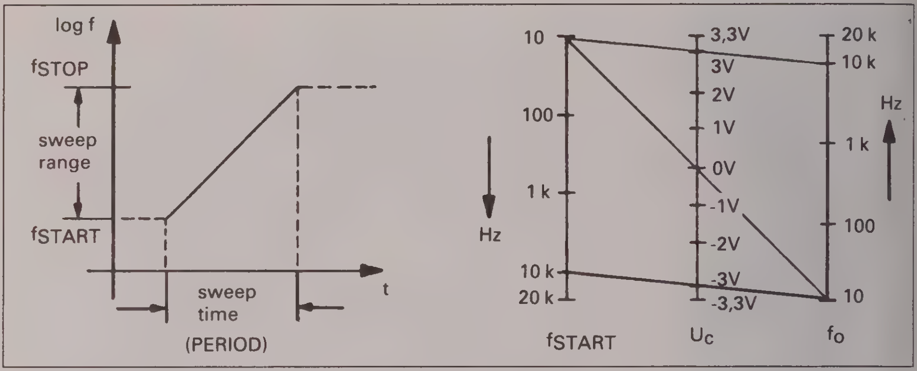
PM 9075 Cable BNC-BNC	11
PM 9560 19-in Rackmount Adapter	130

Service & Support

Warranty

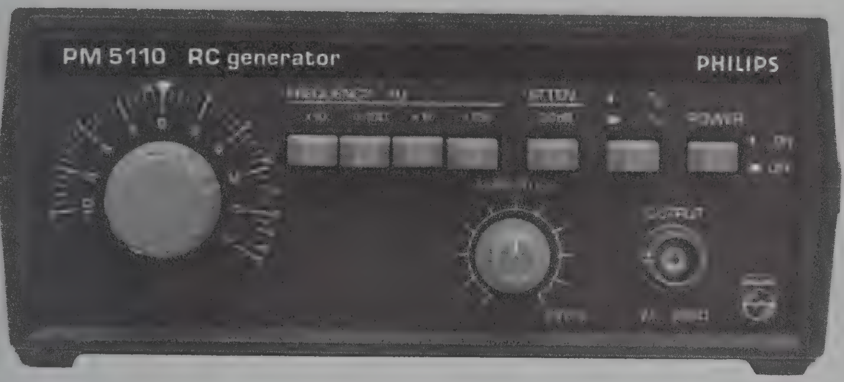
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.



Example of internal single sweep
Internal single sweep from the start- to the stop frequency is started by pressing the button SGLE SWEEP. The characteristic is exponential following the relation $f_o = f_{START} 10^{U}C$ where f_o = instantaneous signal frequency at the output; f_{START} = frequency at the beginning of the sweep represented by the frequency setting; U_c = voltage at the socket SWP VOLTAGE IN/OUT.
Thus a control voltage difference of 1V results in a frequency ratio of 10:1.
At the end of the sweep the output remains at the stop frequency which can be set by the SWP STOP/START control. Resetting the SGLE SWEEP button causes the frequency to return to the start frequency. The sweep time is adjusted with the SWP PERIOD potentiometer. Pre-adjustment of the stop frequency may be performed at the end of the sweep with minimum period, prior to setting the final sweep operation.
The example shown is for the x10k frequency range; the other two ranges should be regarded similarly, with U_c scale reading unchanged.

PM 5110



PM 5110

PM 5110 Low Distortion LF Generator

- Sine and square wave signals
- Frequency range 10 Hz..100 kHz
- 6V pk-pk output and separate TTL output
- Very low distortion 0.02%
- Switchable 20 dB and continuous attenuation
- Compact dimensions and low weight

The PM 5110 has been designed for both educational applications and service work-shops. It provides square and sine wave signals, the latter having a special 'low distortion' position for use on HiFi development as well as alignment and maintenance. Another useful service feature is the switchable 20 dB attenuation.

The generator is 1 kg light and has very compact dimensions. The layout of the front panel is attractive and functional, a feature which is of particular value for educational applications.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 10 Hz...100 kHz (4 subranges, selectable by push-buttons)
ndication: Dial (1...10) LED marker
Setting Error: <4% ±1 Hz
Temperature Coefficient: <0.05%/K (1000 Hz)
Long-Term Drift: (<7h) <1.5 x 10^{-3} (1000 Hz)
Duty Cycle: 50% fixed

Waveforms

Sine wave
Square wave

Output

Attenuation: 20 dB calibrated step plus 40 dB continuously adjustable
Impedance: 600Ω
Short-Circuit Proof: Yes

Sine Wave

Low Distortion Mode: Total harmonic distortion 0.02% at 1 kHz; 0.03% (300 Hz...20 kHz)
Fast Settling Mode: Total harmonic distortion 0.5% (300 Hz...20 kHz)
Max. Open Circuit Voltage: 2 Vrms
Frequency Response of Amplitude: <2% (1000 Hz)

Square Wave

Max. Open Circuit Voltage: 4 Vp-p
Rise and Fall Time: <0.5 µs
Sag: <1% (50 Hz)
Duty Cycle: 50%

TTL

Amplitude High Level: 4.5V ±0.7V
Amplitude Low Level: <0.3V
Sag: <1%
Frequency Response: 3% (1000 Hz)
Rise Time: <30 ns
Fall Time: <15 ns
Fan Out: 10

General Specifications

Power Requirements

Voltage: 115, 230V ±15%
Power Consumption: 4W
Frequency: 60 Hz ±5%

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -40°C...+70°C

Size: 155 mm W x 65 mm H x 180 mm L (9 in W x 4.3 in H x 8.3 in L)
Weight: 1 kg

Included with instrument: Instruction manual, power cable

Ordering Information

Model

January 1989 prices

PM 5110M Oscillator Low Distortion $325

Accessories (Also see page 485)

PM 9075 Cable BNC-BNC 11

Service & Support

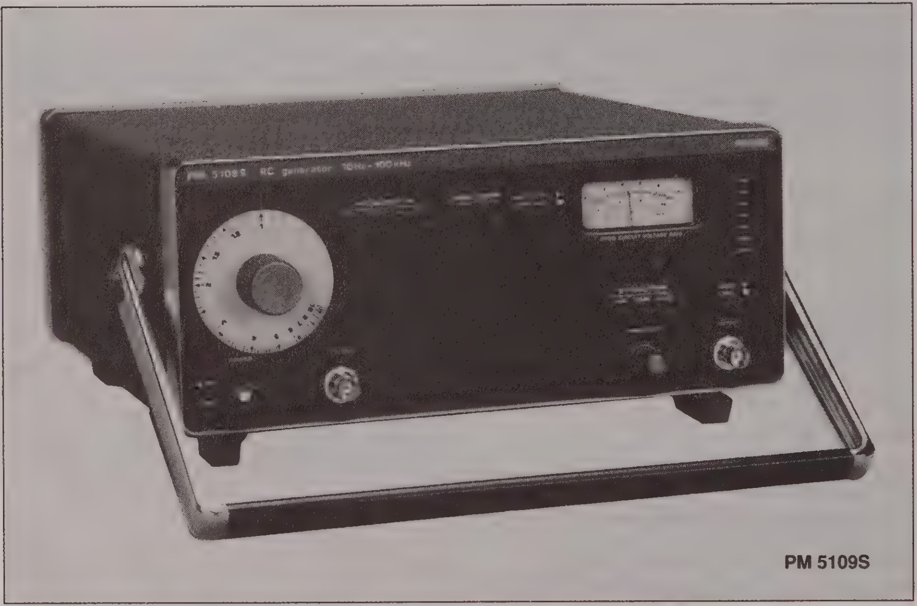
Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 5109/PM 5109S

PM 5109



PM 5109S

PM 5109/PM 5109S Low Distortion LF Generators
Sine and square wave signals
10 Hz...100 kHz frequency range
Output voltage: 30V$_{p-p}$ (asymmetrical), 10V$_{p-p}$ (symmetrical)
Low distortion 0.02%
Symmetrical floating output
Output level indication
Separate TTL and DIN loudspeaker output

The PM 5109 is an RC oscillator offering a low distortion (0.02% at 1 kHz) yet high, 30V$_{p-p}$ (open circuit) output voltage in the asymmetrical mode. It can also be used in a fast settling mode, useful for fast routine work. These features, plus the facility to select asymmetrical or dual floating symmetrical outputs, make it ideal for telecommunication applications as well as for education, R & D, manufacturing and audio equipment servicing. Both output voltages can be attenuated by a continuous control; the asymmetrical output can also be attenuated in steps of 10 dB down to 60 dB. Both pure sine waves or square wave signals are available at frequencies from 10 Hz to 100 kHz; output impedance is switchable for either 600Ω or 50Ω in the asymmetrical mode and 600Ω or LOW Z in the symmetrical mode (see specification).

A DIN loudspeaker connection is provided, which has an impedance similar to the symmetrical low impedance output. This allows direct testing of loudspeakers, regardless of their impedance. A special TTL output for direct connection to TTL circuitry or for synchronization purposes, is also provided.

The open circuit output is monitored by a meter on the front panel and the output range in use is indicated by the appropriate LED, from the seven provided.

For applications where the symmetrical output is not required, a special, economical, version, the PM 5109S is available.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 10 Hz...100 kHz
(4 subranges, selectable by push-buttons)
Indication: dial (1...10)
Setting Error: <±5% ±1 Hz
Temperature Coefficient: <0.05/K
Long Term Drift (<7h): $<1.5 \times 10^{-3}$
Short Term Drift (<15 min): $<0.5 \times 10^{-3}$
Duty Cycle: 50% fixed

Waveforms

Sine wave
Square wave (output B only)

Output

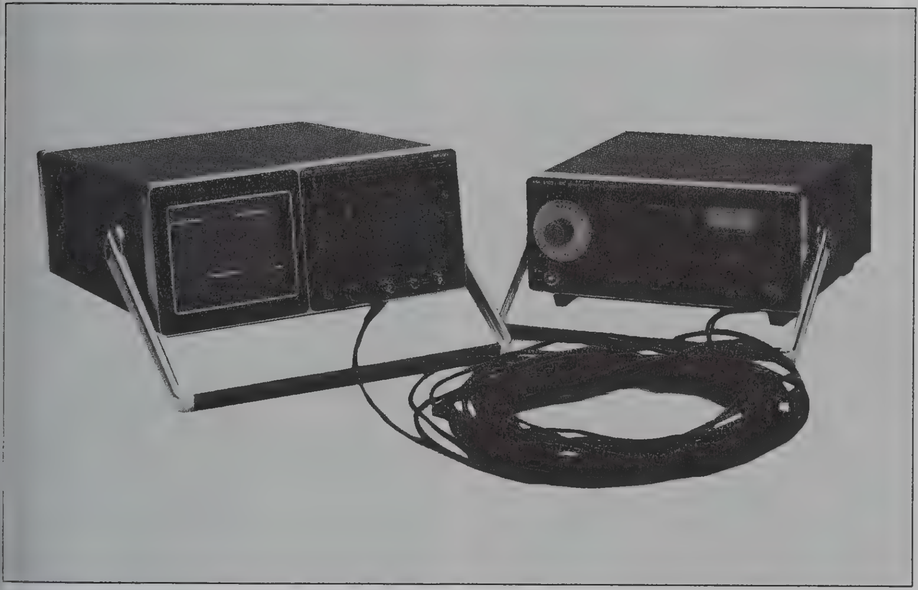
Separate outputs selectable with push-buttons
Symmetrical Output: (4 x 4 mm connector on front panel) (PM 5109 only)

$$\left.\begin{array}{l}\text{a. 2x }300\Omega\\ \text{b. }300\Omega + 300\Omega\\ \text{c. 2 x low Z}\\ \text{d. low Z + low Z}\end{array}\right\}\ \text{not grounded}$$

Asymmetrical Output:
(BNC connector at front panel)
a. 600Ω
b. 50Ω

PM 5109/PM 5109S

Loudspeaker Output: (DIN connector at rear panel) Only active when output Ad is selected
TTL Output: (BNC connector at rear panel)
Open Circuit Output Voltage: (RMS)
0.03...3.16V (output A)
0.1...10V (output B)
Indication: Meter (7 ranges indicated by LED)
Attenuation: 10, 20, 30 dB calibrated steps selectable in any combination (output B only) plus 30 dB continuously adjustable



PM 5109 being used to check the bandwidth characteristic of a long coaxial cable.

Sinewave

Total Harmonic Distortion
(for output Aa, Ab, and B)

- low distortion mode
<0.7% (10 Hz...100 kHz)
<0.03% (300 Hz...20 kHz)

- fast settling mode
<1.5% (10 Hz...100 kHz)
<0.5% (100 Hz...100 kHz)

Total Harmonic Distortion
(for output Ac and Ad)

- low distortion mode
<0.7% (open circuit 20 Hz...100 kHz)
<0.03% (open circuit 300 Hz...20 kHz)
<0.15% (4Ω load, 20 Hz...100 kHz)

- fast settling mode
0.5% (0...4Ω load, 100 Hz...100 kHz)

Frequency Response of Amplitude
±0.2 dB (1 000 Hz, outputs A & B, open circuit)
±0.5 dB (10 Hz...10 kHz, outputs Ac & Ad, 4Ω load)
- 6 dB (70 kHz, outputs Ac & Ad, 4Ω load)

Squarewave

Rise and Fall Time: <0.5 µs
Overshoot and Ringing: <2% (>20 Hz); <1% (>50 Hz)

TTL

Duty Cycle: 50%
Fan Out: 20

Power Requirements

Line Voltages: 110, 128, 220, 238V ±10%
Frequency: 50...100 Hz
Power Consumption: 17W
Dimensions: 310 mm W x 140 mm H x 330 mm L (12.2 in W x 5.5 in H x 13 in L)
Weight: PM 5109: 6.5 kg (14.3 lb); PM 5109S: 5 kg (11 lb)

Included with instrument: Instruction Manual, line cord

Ordering Information

Models

January 1989 prices

PM 5109 RC Generator and Output Monitor	$1200
PM 5109S RC Generator 10 Hz - 100 kHz	1000

Accessories (Also see page 485)

PM 9075 Coaxial Cable BNC-BNC	11
PM 9560 19-inch Rackmount Adapter	130

Service & Support

Warranty
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5785 & PM 5786

PM 5786

PM 5785

PM 5785/PM 5786 125 MHz Pulse Generators

- 1 Hz...125 MHz pulse frequencies
- Rise and fall times from 1 ns
- Time-setting-error indicators
- Excellent 50Ω backmatching
- Dual outputs for simultaneous + and - pulses
- Full external control facilities
- LED indicator for correct trigger levels
- Presettable burst option

PM 5785 and PM 5786: top performance, top economy and assured time-settings.

The PM 5785 and PM 5786 have the speed and versatility to handle virtually any analog or digital circuit testing requirement. Yet, for instruments with such high performance, they are very competitively priced. Fast digital circuitry such as TTL or ECL is easily handled by both generators, and the wide choice of external trigger and gate functions make the setting up of special test signals unbeatably easy.

The difference in the PM 5785 and PM 5786 is the choice between speed and versatility in leading and trailing edge adjustment.

The PM 5785 offers the higher speed of the two. Its leading and trailing edges are equal. Pulse transition times can be selected from three values: 1 ns, 1.5 ns or 2 ns.

The PM 5786 offers a whole-spectrum of transition times from which to choose. It allows such versatility as independent and continuous variable settings of rise and fall times all the way from 2 ns ... 100 ms. In other words, the PM 5786 is best suited for high-speed general-purpose applications such as in research and development, where many different pulse response tests may need to be made.

On the other hand, the 1 ns performance of the PM 5785 is ideal for ultra high-speed testing in quality control (manufacturing), performance checks (maintenance) or testing to limits (development).

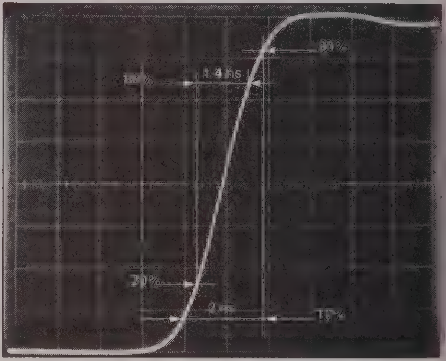


Fig. 1.

Ease of Operation

Both PM 5785 and PM 5786 offer features to simplify operation. Like the unique system of front panel time-setting-error indicator LEDs to provide clear confirmation that all time settings are correct. This prevents erroneous pulses, caused by incorrectly set pulse duration or pulse delay times (and additionally for the PM 5786, rise and fall times) with respect to pulse period.

Versatile Pulse Selection

Additional ease of use results from simple and versatile selection of the desired kind of output pulses: bipolar, positive or negative. Simultaneous positive and negative going pulses can be selected for linear applications, as well as complementary positive or negative pulses for digital applications.

This simple output selection means there is no need for time-consuming manual adjustment of inverter and offset controls. Further, logic 'O' and '1' levels can be changed without the need for interchanging cables by using the COMPL (normal/complementary) switch. The table below shows the possible output combinations that can be selected.

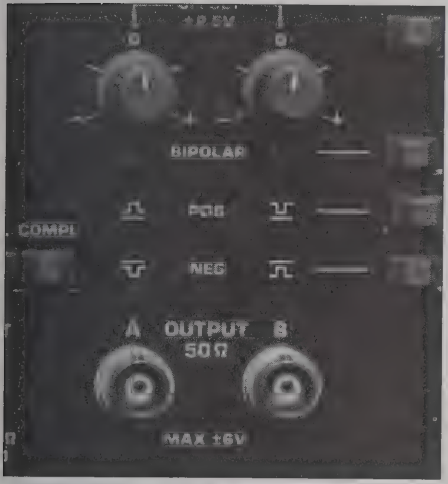


Fig. 2. Shows dual output arrangements with output and pulse mode selectors.

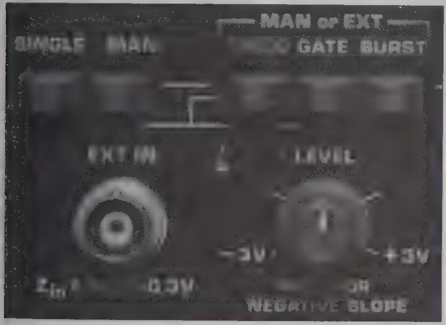


Fig. 3. Shows selection of various external control functions and the external control input.

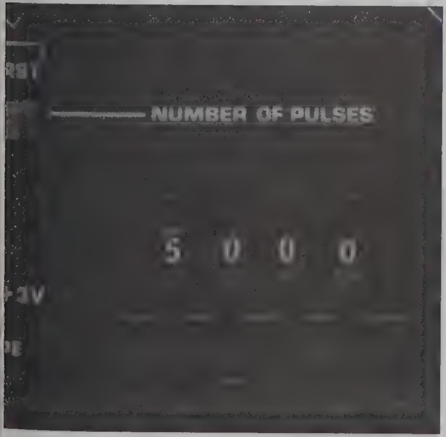


Fig. 4. Option burst function and thumbwheel control.

High-Speed, High-Fidelity Pulses

The PM 5785's ultra high-speed output waveforms have rise and fall times selectable from 1 ns, 1.5 ns and 2 ns, (and with the 20% ... 80% transition times for ECL testing, rise and fall times are 700 ps, 1 ns and 1.4 ns).

A choice of bipolar outputs and high-quality 4-range output attenuator in both the PM 5785 and PM 5786 make these generators very suitable for all kinds of linear applications. Very clean pulses are ensured by the PM 5786's excellent back-matching impedance that absorbs over 90% of reflections from mismatched loads, while the PM 5785 absorbs as much as 95% of reflections.

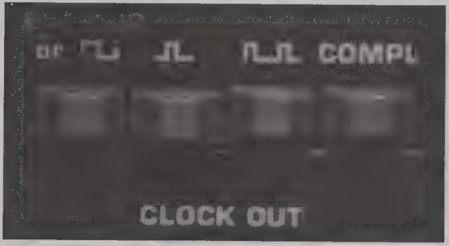


Fig. 5. Pulse mode selectors.

Burst Mode

The PM 5785 and PM 5786 are also available with burst mode options (PM 5785B and PM 5786B), that enable generation of bursts containing selectable numbers of pulses from 1...9999. Pre-selection of the required number of pulses is easily carried-out, using front panel digital switches. Bursts can be triggered either manually or remotely by a signal to the EXTernal INput on the front panel. The use of the presettable burst mode is particularly valuable, for testing memory circuits, shift registers, counters and other digital circuits.

Other functions which can be selected and carried out remotely through the external input include:

- Externally triggered pulses
- Externally gated pulses (gives synchronized bursts of pulses)
- Externally controlled pulse duration.

External control signals can be applied to define the start (and duration) of the various control options. Start/stop conditions can be adjusted with the EXT IN LEVEL control both to select +/- trigger slope and -3V...+3V trigger level. An LED indicates correct triggering.

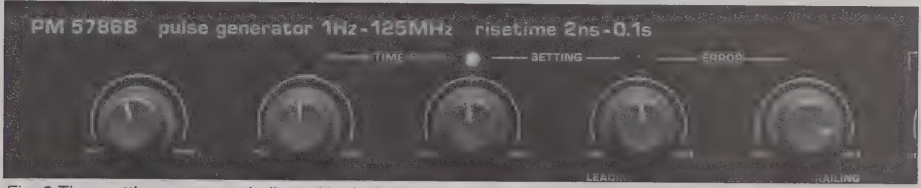
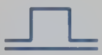
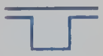
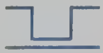
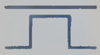
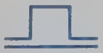
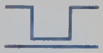
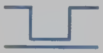
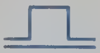
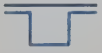
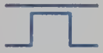
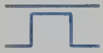
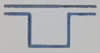


Fig. 6. Time setting errors are indicated by LEDs.

Mode	Normal		Complementary	
Output	A	B	A	B
Bipolar				
Pos				
Neg				

PM 5785 & PM 5786

External Triggering

External triggering enables the PM 5785/ PM 5786 to operate synchronously with external clock signals. All other parameters, such as pulse duration, amplitude etc. are as set on the pulse generator. External trigger signals can vary from 0...125 MHz, or, in the double pulse mode, 0...62.5 MHz.

External Gating

The external gate mode provides external synchronous on/off control of the pulse generator. As long as the external gate signal is present, output pulses are available with the preset pulse parameters.

External Duration

This mode allows the generators to function as input signal conditioners. The external input signal defines frequency and pulse duration, while amplitude, DC offset, rise and fall times and normal/complementary mode selection are defined by the pulse generator settings.

Squarewave Mode

A 'squarewave' mode provides pulses with a constant 0.5 duty factor. This facilitates a quick method of setting the required output repetition rate, without having to consider the other time parameters.

Specifications

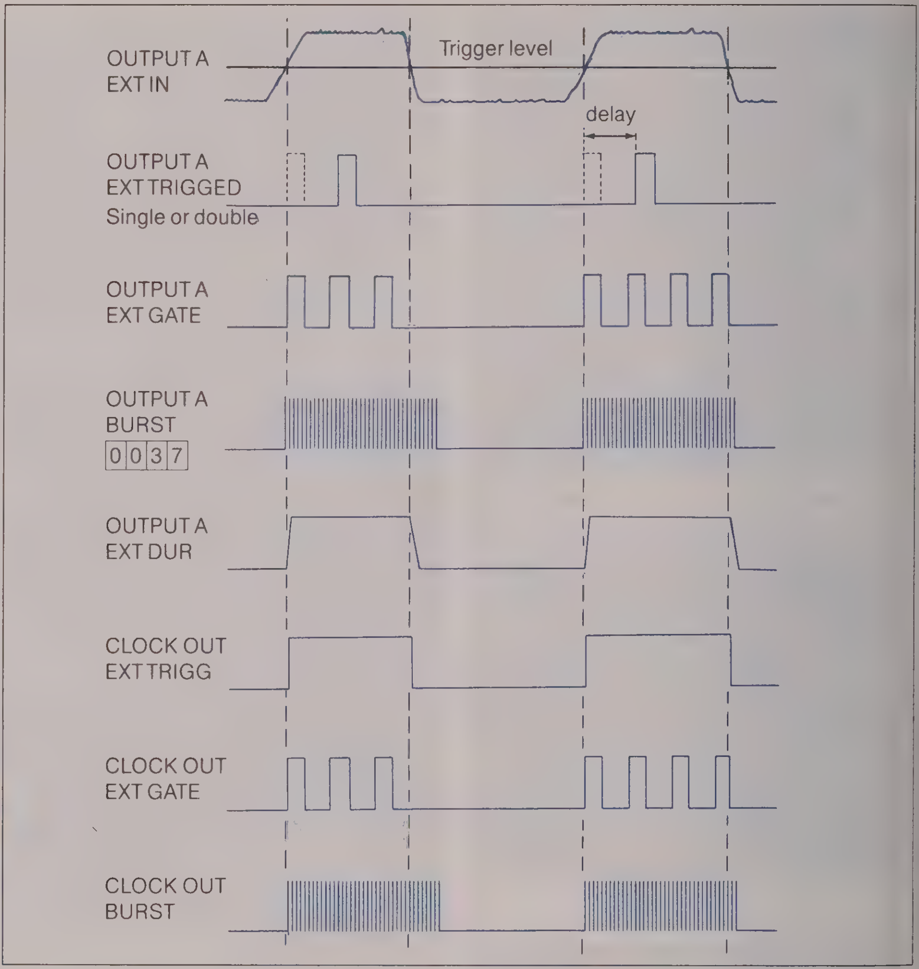
Technical Specifications

Time Parameters

Pulse Repetition Period: 8 ns...1s (1 Hz...125 MHz)
Pulse Delay: 8 ns...100ms
Pulse Duration: 3.5 ns...100 ms or fixed square wave
Jitter: <0.1% of setting ±50 ps

Main Output Pulse Characteristics

Outputs: 2 channels, A and B
Transition Times: At $Z_L = 50\Omega$
PM 5785: 1 ns, 1.5 ns or 2 ns fixed selectable, corresponding to 10%...90% of pulse amplitude. For ECL testing: 700 ps, 1 ns or 1.4 ns fixed selectable, corresponding to 20%...80% of pulse amplitude.
Transition Time Accuracy: ±10% (PM 5785)
PM 5786: <2 ns...>100 ms, continuously variable, corresponding to 10%...90% of pulse amplitude. For ECL testing: the minimum transition time is 1.4 ns, corresponding to 20%...80% of pulse amplitude.



Pulse Amplitude: 0.2V...5V (at $Z_L = 50\Omega$), double amplitude at open output
DC Offset: -2.5V...+2.5V (at $Z_L = 50\Omega$), ±5V at open output
Max. Output Voltage: Pulse amplitude plus DC offset is ±6V at max. Maximum 10V open output voltage within the -6v...+6V range.
Waveform Aberrations: at $Z_L = 50\Omega$
PM 5785: <5% ±10 mV
PM 5786: <5% ±10 mV, <10% for transition times <5 ns
Source Resistance: 50Ω ±5%
Source Impedance:
PM 5785: 50Ω ±5%
PM 5786: 50Ω ±10%

Output Protection: against short- or open- circuit and transients
Pulse Modes:
- Single pulse (delayable)
- Double pulse
- Square wave: 50% ±1% (1 Hz...1 MHz); 50% ±10% (1 MHz...125 MHz)
- Normal or complementary switchable

Output Modes:
Bipolar: simultaneously positive and negative polarity
Pos: positive polarity, normal and complementary
Neg: negative polarity, normal and complementary

PM 5785 & PM 5786

External Operating Modes

TRIGG: Ext. triggered pulse repetition: DC...125 MHz or manual single shot
GATE: Synchronous gating. Ext. input signal starts and stops the generator
BURST: Internally generated burst with digital switch selection of number of pulses: 0...9999, started by ext. input signal or manual control
EXT DUR: External duration gives pulses with same duration and repetition rate as external input signal, all other pulse parameters are set via the generator

External Input

Range: DC...125 MHz; min. pulse duration 3.5 ns
Operating Input Voltage Range: 0.5...15 Vpp
Coupling: DC
Input Impedance: 1 MΩ//25 pF
Trigger Level: -3V...+3V
Trigger Slope: + and -
Trigger Indicator: Tri-state LED indicator for correct trigger level setting
Max. Input Voltage Without Damage: 260 Vrms at ≤440 Hz, declining to 15 Vpp at 125 MHz

Internal Clock Output

Main output pulse is delayable with respect to internal clock output, which can thus be used as pre-trigger
Amplitude: +2.5V into 50Ω
Output Impedance: 50Ω (typ)
Transition Time: Approx. 1 ns
Pulse Duration: Square wave, 50% ±1% (1 Hz... 1 MHz), 50% ±10% (1...125 MHz)
Output Protection: Against short- or open- circuit and transients

Time Setting Error Indicators

Warning with LED indicators for erroneous settings of too long times for pulse delay and/or pulse duration (on PM 5785 and PM 5786) as well as for leading- and trailing edge transition times (PM 5786 only).

General Specifications

Power Requirements

Line: 100V, 120V, 220V and 240 Vrms ±10%; 120 VA, 50...60 Hz
Safety: According to IEC 348 and CSA 556B
Mains Interference: Below VDE 0871 (B) and MIL STD 461A

Environmental Conditions

Temperature:
Rated Range of Use: 0°C...+50°C
Storage and Transport: -40°C...+70°C
Humidity:
Operating: 10...90% RH, no condensation
Storage: 5...95% RH
Altitude/Barometric Pressure:
Operating: 5000m (15000 ft) - 53.3 kN/m2
Storage: 15000m (50000 ft) - 15.2 kN/m2
Size: 300 mm W x 145 mm H x 470 mm L (11.8 in W x5.7 in H x 18.5 in L)
Weight:
Net: 9.5 kg (21 lbs)
Shipping: 11.5 kg (25 lbs)
Included with instrument: Manual, power cord

Ordering Information

Models

January 1989 prices

PM 5785/00 1 ns Pulse Generator; excluding preset burst unit	$3385
PM 5785B/00 1 ns Pulse Generator; including preset burst unit	3790
PM 5786/00 2 ns Pulse Generator; excluding preset burst unit	3385
PM 5786B/00 2 ns Pulse Generator; including preset burst unit	3790

Accessories (Also see page 485)

PM 9581/01 50Ω Feed-through Termination; 3W	60
PM 9584/02 50Ω T-piece (matched power-splitter)	52
PM 9585/01 50Ω Feed-through Termination; 1W	30
PM 9588/01 50Ω Coaxial Cable Set with calibrated delay times	265

Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5716

PM 5716

PM 5716 50 MHz; ±20V Pulse Generator

- 1 Hz...50 MHz repetition rate
- 6 ns...100 ms rise and fall times
- 2V..20V amplitude, within the range of -20V...+20V
- Independent control for upper and lower pulse levels
- Pulse amplitude limiter to protect device under test
- Built-in 50Ω backmatch, no need for external termination
- Versatile facilities for external triggering, gating and pulse amplifying

This truly universal pulse generator has been designed to meet all MOS logic testing requirements as well as TTL and other HNIL circuits.

It meets the exacting performance criteria demanded by this wide range of devices without any sacrifices of, for instance, fast transition times or special outputs for TTL.

Moreover, the wide range of repetition rates, delay, duration and transition times makes the PM 5716 an ideal pulse source also for analog applications.

This instrument therefore introduces a new dimension to the existing range of Philips pulse generators and new standards in pulse generator design and performance.

Pulse Amplitudes to 20V

The main pulse amplitude from the PM 5716 is continuously adjustable between 2V and 20V.

The pulse level setting is done with two independent sliding potentiometers with ranges from -20V to +20V. The two sliders are mechanically interlocked in such a way that they cannot pass each other and the maximum separation corresponds to a 20V pulse amplitude. (Fig. 1)

The generator has a source impedance of 50Ω and the maximum output amplitude is 20V into ≥5 kΩ. Into 50Ω this value is 10V. The front panel scale is graduated for both cases. The very good output stage of the PM 5716 maintains the 20V pulse amplitude over the whole frequency range.

The PM 5716 is designed for ease of operation. The square wave pulse mode gives freedom from selecting delay and duration; the operator need only set the repetition time, amplitude and shortest transition time and the pulse output.

As can be seen from the illustration it is easy to read pulse amplitude directly from the scales.

By avoiding the use of double function controls the PM 5716 has become an instrument which is very convenient to operate.

Amplitude Limiter

The PM 5716 has as standard an amplitude limiter to protect the device under test. (Fig. 2) When the MOS supply voltage is connected to the limiter inputs your circuits are automatically safeguarded against excessive pulse levels.

The pulse levels can not exceed the upper/lower levels of the limiting voltages. This makes it possible also to remotely control the output levels within the range set by the sliders.

Backmatched 50Ω Output

The built-in 50Ω termination in the PM 5716 is compensated for the reactive impedance components of the output stage.

Fig. 3 which shows a 20V pulse with 6 ns rise time fed into a 1 meter open ended cable, illustrates how the internal termination absorbs the reflection. The residual reflection from the PM 5716 is guaranteed to be less than ±3% with this set-up.

This backmatch makes it possible to work with unterminated cables and high ohmic loads without spending time on checking the waveform.

The benefits gained from this specially designed output are summarized as follows:

- Reflections from all kind of mismatches are absorbed in the generator
- Gives a better waveform, less dependent on external load
- The fixed load means protection of the output stage
- Ideal for high ohmic loads such as MOS circuits
- No need for external termination — easier to use

Transition Times

In the PM 5716 the transition time is not dependent on the amplitude.

This gives freedom to vary the amplitude during a test sequence without having to check and readjust the rise and fall time.

The repetition and transition time ranges in the PM 5716 far exceed the requirements for the MOS logic of today. This makes the generator a suitable pulse source for new developments in MOS in the years to come. The very good characteristics of the rise time circuit are obvious. Linearity is excellent and the pulse has hardly any over shoot.

High Ohmic Trigger Input

In logic testing it is often desirable to trigger a pulse generator from the circuit under test. The trigger take-off must then be of sufficiently high ohmic value to avoid overloading the circuit under test. The PM 5716 has for that reason a trigger input impedance of 1 MΩ//20 pF which is suitable for MOS logic.

The trigger level in the PM 5716 is variable from -2V to +2V enabling triggering from all kinds of logic and most analog sources.

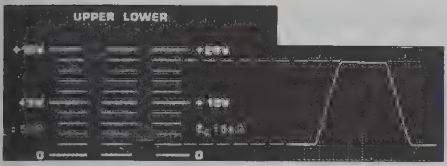


Fig. 1. Independent slide potentiometers for setting maximum and minimum pulse levels.

Clock and Auxiliary Outputs

The auxiliary output of the PM 5716 gives a +2.5V pulse into a 50Ω load. As the source is backmatched by 50Ω a +5V amplitude across high ohmic loads is available.

The pulse always has set delay and duration and a 6 ns transition time.

The clock output always gives symmetrical pulses which are suitable for use as a time reference, because of the fixed duty factor.

Output Protection

The reliability of a signal source is most important. But pulse generator outputs exposed to all kind of reflections, external DC-levels and transients, have always been difficult to safeguard.

The PM 5716 includes an output protection system of diodes shorting any external transients applied to the internal supply voltage. In the case of external DC-levels, the whole internal voltage supply (which is floating) is shifted to avoid overload of the output transistors. The two 5V outputs are also protected with diodes against external transients.

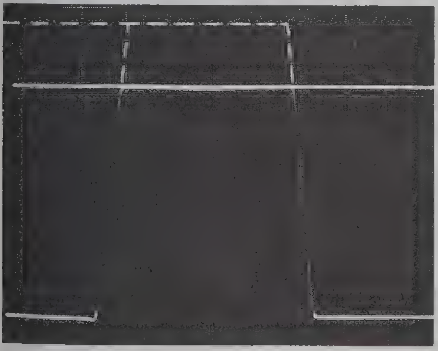


Fig. 2. Pulse limiter protects MOS circuit under test against excessive input pulse amplitudes.

Specifications

Technical Specifications

Repetition Rate

Internal: 1 Hz...50 MHz variable in 8 ranges with continuous control within the ranges
Jitter: ≤0.1% or 50 ps whichever is greater
External: DC...50 MHz

Pulse Delay

10 ns...100 ms. Variable in 7 ranges with continuous control within the ranges.
Jitter: ≤0.1% or 50 ps whichever is greater

Pulse Duration

10 ns...100 ms. Variable in 7 ranges with continuous control within the ranges.
Jitter: ≤0.1% or 50 ps whichever is greater.
Duty Factor: More than 50%. Duty factor over 99% possible with complementary mode.

Main Output Pulse Characteristics

Amplitude: 2V...20V between -20V and +20V with 5 kΩ load
1V...10V between -10V and +10V with 50Ω load
Rise and Fall Times: ≤6 ns...100 ms, (at amplitude below 4V (2V) from 8 ns).
Independent continuous controls within 8 selectable ranges. The transition time remains constant when the pulse amplitude is varied.
Source Impedance: 50Ω compensated, ideal for driving MOS circuits without terminating load. A total reflection of a 6 ns rise time pulse gives less than ±3% distortion.
Waveform Aberrations: ≤5% for all transition times
Amplitude Limiter: The upper (lower) pulse level may be limited by an external DC-source to any value between +20V and -18V (+18V and -20V). With high ohmic load the max. output level is equal to the limiter levels. With 50Ω load, 50% of the levels.
The input resistance of the limiter measured between upper or lower terminals and earth is ≥1 kΩ.
Protection: Short and open circuit safe
Protected against external DC-voltages between ±20V. Special transient protection circuits built in.
Timing: The pulse is delayed 50 ns plus set delay from an external trigger pulse.

Clock Pulse Characteristics

Amplitude: +2.5V into 50Ω and 5V into 5 kΩ
Source Impedance: 50Ω
Rise and Fall Times: Approx. 6 ns
Duty Factor: 50% ±5% (in fastest range 25-45% duty factor)
Protection: Short and open circuit safe, diode protection against transients
Timing: Pulse occurs approx 35 ns plus set delay ahead of main pulse and 15 ns after external trigger pulse

Auxiliary Pulse Characteristics

Amplitude: +2.5V into 50Ω and +5V into 5 kΩ
Source Impedance: 50Ω
Rise and Fall Times: Approx 6 ns
Duty Factor: As set by 'DURATION'
Pulse Mode: Single or double pulses
Protection: Short and open circuit safe, diode protection against transients
Timing: Pulse occurs approx 15 ns plus set delay ahead of main pulse and 35 ns after external trigger pulse

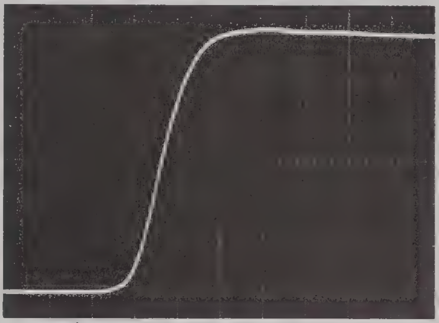


Fig. 3.

External Triggering/Gating

Electrical: Frequency range: DC...50 MHz
Sensitivity: 200 mV
Trig Level: Variable -2V to +2V, with 10:1 probe -20 to +20V
Trig Slope: Selectable leading or trailing edge
Max. External Voltage: ±20V
Input Impedance: 1 MΩ//20 pF suitable for probes
Manual: Single shot by means of push button

Modes of Operation

1	INT CLOCK	Internal clock gives repetition rates from 1 Hz to 50 MHz
2	MAN TRIGG	Manual trigger gives one single/double pulse with set duration or one pulse with same duration as the manual trigger pulse.
3	EXT GATE _⊓_ ‾⊔‾	Gated pulses. First pulse coincides with leading/trailing edge of gate pulse.
4	EXT TRIGG _/‾ ‾_	Triggering on leading/trailing edge of external pulse.
5	EXT DUR	Pulses with same duration and repetition rate as external pulses.

Pulse Modes

1	⊓⊔	Gives a square wave on main output (50% ±5%; approx 25% duty factor in fastest range). And gives single pulses with set duration on aux. output.
2	_⊓_	Gives single pulses with set duration on both main and aux. output.
3	⊓_⊓_	Gives double pulses with set duration on both main and aux. output.
4	NORM	'Normal' gives pulses as previously described.
5	COMPL	'Complementary' gives the complement to the set pulse on main output only.

PM 5716

General Specifications

Line Voltages: 85V...115V, 100V...130V, 200V... 265V; switchable
Frequency: 50 Hz or 60 Hz solderable
Power Consumption: 90 VA
Size: 280 mm W x 133 mm H x 360 mm L (11 in W x 5.2 in H x 14.2 in L)
Weight: 9 kg (19.8 lb)

Ordering Information

Model

Model	January 1989 prices
PM 5716/00 Pulse Generator	$3375

Accessories (Also see page 485)

PM 9581/01 50Ω Feed-through Termination 3W	60
PM 9584/02 50Ω T-piece (power splitter)	52
PM 9585/01 50Ω Feed-through Termination 1W	30
PM 9588/01 Coaxial Cable Set (5x1 ns, 4x2 ns, 3x3 ns, 3x10 ns)	265

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5712 & PM 5715

PM 5712

PM 5715

PM 5712 & PM 5715 50 MHz Pulse Generators

Frequency range: 1 Hz ... 50 MHz

Rise/fall times: PM 5712, 4 ns fixed; PM 5715, 6 ns ... 500 ms, variable

Amplitude range: 0.2 ... 10V

DC offset: +2.5V

Facilities for: manual and ext. triggering, gating, pulse shaping

Pulse modes: single/double, norm/inverted, pos/neg

Applications

The universal 50 MHz pulse generators PM 5712 and PM 5715 have been designed for medium fast, pulse response testing applications.

They can handle virtually any analog or digital circuit testing requirement up to 50 MHz. Their speed and the wide 0.2 ... 10V output voltage range makes these generators ideal for testing of all MOS- and TTL- compatible circuits.

A second output (auxiliary output) supplies pulses, similar to the main output pulses, yet with fixed TTL-compatible levels.

The capability of producing double pulses, with variable delay, allows these instruments to be used for analysis of pulse pair resolution of digital and analog circuits.

An adjustable DC offset can be used to test circuit tolerances for variations in logic levels.

Their versatility is enhanced by extended facilities for external control of e.g. manual and external triggering, synchronous gating and external duration (pulse shaping).

PM 5712 Versus PM 5715

The main difference between the models is found in the facility for transition time setting.

The PM 5712 is primarily intended to supply pulses of positive polarity. However, negative pulses up to -5V can be generated by use of the DC offset and the normal/inverted switch.

The PM 5712 offers a fixed rise- and fall-time of 4 ns. Compared to the PM 5715, this unit is somewhat faster and is more economically priced.

This makes the PM 5712 ideal for go/no-go and performance limit tests, such as those in quality control (manufacturing) and performance checks (maintenance).

On the other hand, the PM 5715 covers a much wider spectrum of applications. It features continuously variable settings of transition times, all the way from 6 ns to 500 ms, with separate controls for rise- and fall-time.

In addition, the PM 5715 allows selection of both positive and negative pulses, over the full pulse amplitude range of -10 to +10V.

In other words, the PM 5715 is best suited for general-purpose applications such as in research and development, where a wide variety of different pulse response tests may need to be made.

PM 5712 and PM 5715

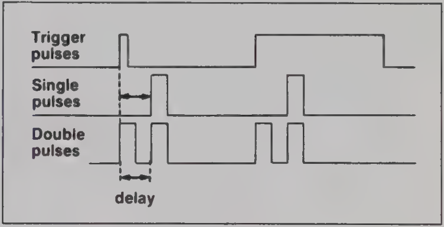
Both models offer three different pulse modes to select from:

- Single pulses
- Double pulses
- T/2 pulses

Testing of digital circuitry is facilitated by the possibility to select of either normal or inverted pulses and the variety of external control facilities.

Single Pulse Mode

In the single pulse mode, continuous pulses up to 50 MHz are generated with adjustable repetition time. Also pulse duration and delay (with respect to the sync. output) are variable.



Double Pulse Mode

In the double pulse mode, twin pulses are generated, of which the pulse pair frequency is variable up to 25 MHz. The pulse duration is commonly set for both pulses, while the delay between the pulses is variable.

Square-Wave or T/2 Mode

In the T/2 mode, the generators supply fixed square wave pulses, irrespective of the settings for pulse delay and pulse duration.

Normal/Inverted

An additional normal/inverted switch allowing the logic state of the pulses to be changed. In the normal mode, the generators can supply pulses with duty cycles of from nearly 0% to more than 50%, whilst in the inverted mode, duty cycles of nearly 100% can be obtained.

External Triggering

External triggering enables the PM 5712/PM 5715 to operate synchronously with external clock signals. All other parameters, such as pulse duration, amplitude, etc. are set on the pulse generator. External trigger signals can vary from 0 ... 50 MHz or, when in the double pulse mode, 0 ... 25 MHz.

External Gating

The external gate mode provides an external synchronous on/off control over the pulse generator. Bursts of output pulses are supplied, only during the presence of the external gate signal. The first pulse coincides with the trailing edge of the gating signal, the last pulse is completed even if the gating signal ends during the pulse.

External Duration

Simultaneous selection of external triggering and the T/2 mode enables the generators to function as input signal conditioners. The external input signal defines frequency and pulse duration, while amplitude, DC offset, rise- and fall-time and normal/inverted mode selection are defined by the pulse generator settings.

PM 5712 & PM 5715

Specifications

Technical Specifications

Time Parameters

Pulse Repetition Time: 20 ns ... 1s (1 Hz ... 50 MHz)
Pulse Delay: 10 ns ... 100 ms
Pulse Duration: 10 ns ... 100 ms

Transition Times Main Output: Corresponding to 10 ... 90% of pulse amplitude, at amplitudes of ≤5V and $Z_L = 50\Omega$
PM 5715: 6 ns ... 500 ms
PM 5712: 4 ns fixed

Jitter: ≤0.1% of setting ±50 ps

Main Output Pulse Characteristics

Pulse Amplitude: 0.2V ... 10V at $Z_L = 50\Omega$
Polarity:
PM 5715: + or - switchable
PM 5712: + only. Pulses within -5V ... +10V possible, using DC offset and norm/inv

Transition Times: Corresponding to 10 ... 90% of pulse amplitude, at amplitudes of ≤5V and $Z_L = 50\Omega$
PM 5715: 6 ns ... 500 ms
PM 5712: 4 ns fixed

DC Offset at $Z_L = 50\Omega$:
PM 5715: -2.5V ... +2.5V
PM 5712: -5V ... +2V

Max Output Voltage: Pulse amplitude and DC offset max. +10V
Waveform Aberrations:<±5% of set amplitude
Source Impedance: Current source of 200 mA in 10V range, terminated with internal 50Ω in 5V and lower ranges.
Pulse Modes:

- Single pulse (delayable)
- Double pulse
- T/2, 50% duty cycle, 50 ±20% duty cycle in 20 ns and 100 ns repetition range

Logic Mode: Normal or inverted
Output Protection: Against short or open circuit

Auxiliary Pulse Output Characteristics

Pulse Amplitude: TTL-compatible, +2.5V into 50Ω or +4.5V open circuit
Source Impedance: 50Ω
Pulse Modes: Single pulse, double pulse, not T/2. The pulse occurs approx. 12 ns ahead of main pulse.
Output Protection: Against short or open circuit

Sync. Output

Function: Pre-trigger output, main output pulse is delayable with respect to sync. output
Amplitude: +1.5 V at $Z_L = 50\Omega$, +3V open circuit
Output Impedance: 50Ω
Pulse Duration: Square wave
Output Protection: Against short or open circuit

External Operating Modes

TRIGG: Ext. triggered pulses, range: DC... 50 MHz or manual single shot
GATE: Synchronous gating, external signal starts and stops the generator
EXT DUR: External duration gives pulses with same duration and repetition rate as external input signal, all other pulse parameters are set via the generator

External Input

Function: For external trigger, gate and duration
Range: DC ... 50 MHz
Coupling: DC
Input Impedance: Approx 220Ω at <1.5V, approx 800Ω at >1.5V
Trigger Level: ≥+1V
Trigger Slope: Positive
Max. Input Voltage Without Damage: ±12V

General Specifications

Power Requirements

Line: 100 ... 130V and 200 ... 260V switchable, 85 ... 115V and 170 ... 230V solderable
Line Frequency: 50 ... 400 Hz
Power Consumption: 70 VA

Environmental Conditions

Temperature Range:
Operating: 0...40°C
Storage: 0...70°
Size: 210 mm W x 130 mm H x 275 mm L (8.3 in W x 5 in H x 10.8 in L)
Weight: 4 kg (8.8 lb)

Included with instrument: Manual, power cord

Ordering Information

Models

	January 1989 prices
PM 5712/08 Pulse Generator	$1485
PM 5715/11 Pulse Generator	1745

Accessories (Also see page 485)

PM 9581/01 50Ω Termination (3W)	60
PM 9585/01 50Ω Termination (1W)	30
PM 9588/01 Coaxial Cable Set	265
PM 9584/02 50Ω T-Piece	52

Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5705

PM 5705

PM 5705 10 MHz: 15V Output Pulse Generator

- 0.1 Hz...10 MHz frequency range
- TTL-compatible outputs, both normal and complementary
- 1.0V to 15V into 50Ω for TTL, HNIL and MOS applications
- Baseline offset from 0 up to +2V
- Resettable, engraved scales
- External triggering on positive or negative slope; gating and single shot facilities

The PM 5705 is an ideal low-cost generator for a wide range of TTL MOS and HNIL applications. There are two TTL outputs, normal and complementary with sufficient power for up to 30 gates.

For MOS and HNIL logic there is a 1 to 15V output. For current sink applications a 50Ω internal switchable load is included. This all-round performance is complemented by a logical front panel layout and the use of engraved, resettable scales.

These allow the pulse parameters to be set to a high degree of accuracy without employing an oscilloscope. This feature is particularly useful for educational applications. When the PM 5705 is used as a clock generator only the repetition time has to be set and the square wave push button depressed.

The baseline offset of up to 2V is an additional useful feature, used to test biased circuits and components — for example the (zero) level in TTL.

Pulse bursts can be produced using an LF generator connected to the trig/gate input. The PM 5705 can also be triggered by an external pulse source, on either the positive or negative slopes.

Specifications

Technical Specifications

15V Pulse Output

Repetition Rate: 0.1 Hz...10 MHz variable in 8 ranges with continuous control within the ranges. Jitter less than 0.1%

Duration: 50 ns to 500 ms variable in 7 ranges with continuous control within the ranges. Jitter less than 0.1%

Duty factor approaching 100% using complementary pulse. More than 50% in normal pulse mode

Delay: In square wave mode the positive edge of the TTL complementary is delayed from the complementary main pulse. The delay time is the set duration subtracted from half the repetition time.

Amplitude: Continuously variable from +1V to +15V into 50Ω.

Max. current 300 mA

Source Impedance: Voltage source with about 300Ω or 50Ω termination

Polarity: Positive

Modes of Operation: Normal or complementary

Baseline Offset: Continuously variable from 0 to +2V Max. offset current 80 mA. Only the baseline is shifted.

Ramp Time: ≤10 ns at 5V and lower amplitudes with 50Ω internal or external termination. Typically 10 ns at 10V and 15 ns at 15V. (Typical rise time 6 ns).

Waveform Aberration: Less than ±5% between 3V and 15V into 50Ω and base line offset 0V.

Protection: Short and open circuit safe

TTL Pulse Outputs

Repetition Rate: 0.1 Hz...10 MHz variable in 8 ranges with continuous control within the ranges. Jitter less than 0.1%

Duration: 50 ns to 500 ms variable in 7 ranges with continuous control within the ranges. Jitter less than 0.1%

Duty factor approaching 100% using complementary pulse. More than 50% in normal operation.

Delay: In square wave mode the positive edge of the TTL complementary is delayed from the main complementary pulse. The delay time is the set duration subtracted from half the repetition time.

Amplitude: TTL level. Fan out 30 gates. About 4.5V open circuit

Polarity: Positive

Modes of Operation: Normal and complementary

Ramp Time: About 10 ns

Waveform Aberration: Less than 5% into 50Ω

Protection: Short and open circuit safe

Pulse Output: 50Ω TTL linedriver with filter for waveform correction, designed for 50Ω load

PM 5705

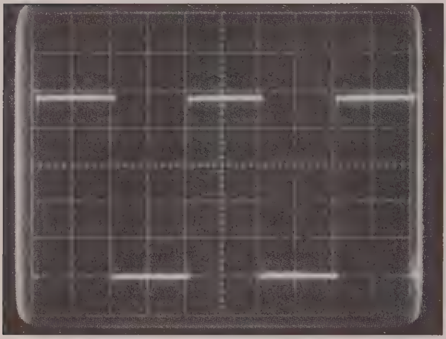


Fig. 1. Squarewave at 5 MHz

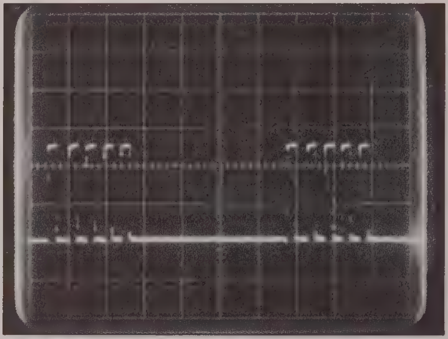


Fig. 2. Gated pulses

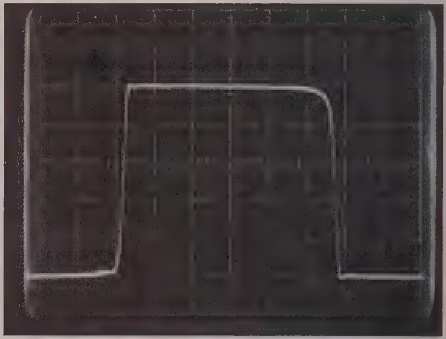


Fig. 3. TTL output

General Specifications

External Triggering and Gating

Level: > + 1V to trigger or gate the generator. Max. ±20V
Slope Selection: Positive or Negative slope
Frequency: 0...10 MHz
Input Impedance: Approx. 1 kΩ
Gating signal turns the generator 'off'. First pulse coincides with trailing edge of gating pulse.
Pulse Shaping: In square wave mode with repetition time set to external the frequency and duration of the output pulse are determined by the trigger pulses.
Single Shot: Single shot facility by means of push button. In square wave mode the TTL pulse duration is determined by the time the push button single shot is depressed.
Manual Gating: Depressing the single shot push button inhibits pulses when the generator is internally triggered.
Temp. Range: 0...40°C

Power Requirements

Line Voltage: 90...110, 100...130, 180...210 and 200...260V solderable
Frequency: 50...400 Hz
Consumption: 40 VA
Size: 210 mm W x 130 mm H x 275 mm L (8.3 in W x 5 in H x 10.8 in L)
Weight: 3.5 kg (7.7 lb)
Included with instrument: 1 line cable, 1 instruction manual

Ordering Information

Model	January 1989 prices
PM 5705/04 Pulse Generator	$940

Accessories (Also see page 485)

PM 9581/01 50Ω Termination (3W)	65
PM 9584/02 50Ω Mixing Piece	52
PM 9585/01 50Ω Termination (1W)	30
PM 9588/01 Coaxial Cable Set	265

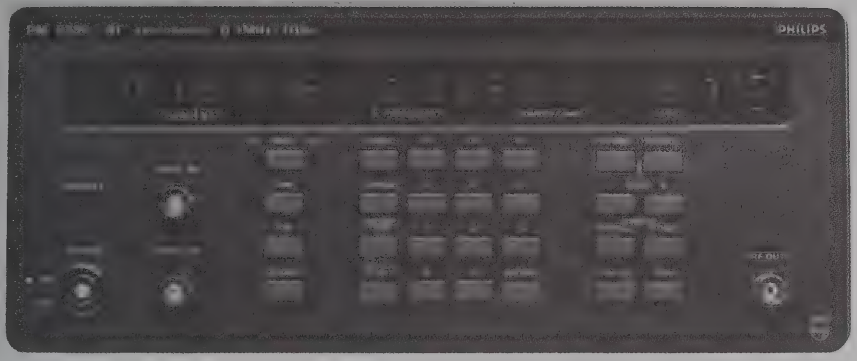
Service & Support

Warranty

One-year product warranty. (See Page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5390 & PM 5390S



PM 5390

PM 5390/90S Programmable RF Generator with Video Modulation

- Frequency range 100 kHz...1019.99 MHz
- Built-in GPIB/IEEE-488 interface with remote control LED indication
- Inputs for external AM and FM wideband modulation and external video source
- Push-button controlled video sound and carrier modulation
- Push-button selection of frequency, Δ frequency, sweep time, level and Δ level
- Step function settings for frequency/level, increment/decrement sweep facilities
- Keyboard facilitates swift and accurate entry or all digital parameters
- Output levels from -127 dBm to -7 dBm (PM 5390) or to +13 dBm (PM 5390S)

The PM 5390 and PM 5390S, operating beyond 1 GHz, will find wide application in the generation of carrier and subcarrier frequencies for TV, radio and communications, in sensitivity tests and radiation measurements.

Sweep measurements on broadband amplifiers and IF filters, plus signal simulation such as gain/bandwidth and conversion loss or antenna gain, can easily be accommodated.

It will be of especial interest for applications associated with cable TV bands, currently increasing UHF ranges and (ultimately) satellite TV. Moreover, the trend towards using programmable generators in automated testing systems, further extends its application potential.

The PM 5390/90S is a fully-programmable 1 GHz RF generator and provides AM, FM and video modulation, plus a wide range of sweep measurements and both automatic and manual frequency-stepping facilities. The output (100 kHz to 1020 MHz) is highly stable and accurate, and frequency, signal amplitude, frequency increment and sweep time can be digitally selected and displayed.

The heart of the PM 5390/90S is the main RF oscillator which is used for mixing frequencies generated by voltage controlled oscillators (VCOs) under phase-locked loop control. A 5 MHz crystal oscillator provides a highly stable reference source.

The main oscillator comprises four separate voltage-controlled oscillators (VCOs) from which six discrete frequency bands are produced. Two of these are developed within the main oscillator by a frequency-mixing process. The generated bands cover the ranges 340 to 510 MHz, 510 to 680 MHz, 680 to 850 MHz and 850 to 1020 MHz. Fig. 1 shows a block schematic of this circuitry.

Frequency control is achieved by comparing the output signal from VCO1 mixed with the relevant frequency generated by oscillator VCO2 to a signal from the reference oscillator.

Signals Divided Down

Both signals are divided down to 1 kHz (the reference signal) by a fixed reference divider and the output signal by a programmable divider controlled by the microprocessor. A phase detector ensures that the signals agree in both phase and frequency.

The output from the main oscillator is then fed out to an automatic level control. Amplitude modulation can be added after this stage. Video modulation is also applied here. The final section provides fine and coarse attenuation.

The lower two frequency bands are obtained by mixing the output of the main oscillator with the 510 MHz output of oscillator VCO3. Frequency modulation is applied to this oscillator to ensure constant deviation at different output frequencies.

Standard integrated circuits are used in the phase-locked loop control system. These were developed initially for similar applications in television and broadcast work. These LSIs are designed for use in microprocessor circuits and need few peripheral components.

Careful Attention to Shielding

Particular care has been taken to ensure negligible RF interference. The RF circuitry is split into two separately shielded sections — oscillators in one part and the digital control circuitry in the other — to reduce any possible crosstalk.

As the accuracy of the output frequency is directly related to that of the crystal-controlled reference oscillator, this is contained in a specially shielded compartment in the control box. The circuitry is designed to ensure stability of better than 1 part in 10^{-6}.

Built-In Microprocessor

The built-in microprocessor enables simple and rapid selection of parameters and values via front-panel-mounted push-buttons, and permits the storage of up to 8 sets of parameters for subsequent use. All values are clearly displayed on four separate LED displays. Full remote control is assured via the integral GPIB/IEEE*/IEC interface.

Internal and external AM and FM modulation are important features.

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* *The terms GPIB an IEEE-488 may be used interchangeably throughout this catalog.*

PM 5390 & PM 5390S

Modulation

AM modulation is effective over the full 1 GHz range, FM modulation is up to 340 MHz.

Video modulation facilities are possible over the full video band with the choice of internal or external AM or FM sound. This makes the instrument an invaluable tool in, for example, video equipment production testing.

Internal or External Sweep

Single and continuous sweep modes can both be internally or externally controlled; sweep time can be varied from 0.05 to 20 seconds. Manual or automatic incremental frequency-changing is also provided in the range 1 kHz to 50 MHz, positive or negative. This latter facility is ideal for random sequence testing of TV and/or radio channels.

Extremely Wide Application Potential

The PM 5390/90S is thus designed to cater to almost every possible application in industrial electronics including audio, video and communications. As such, it meets today's need for a versatile, easy-to-use RF signal source having the most comprehensive modulation facilities; with reserve performance for tomorrow.

Specifications

Technical Specifications

Frequency

Frequency Range: 100 kHz...1019.99 MHz
Setting: Keyboard, IEEE/IEC bus
Display: 6-digits LED display
Resolution: 0.1-1000 MHz - 1 kHz; ≥1 GHz - 10 kHz
Setting Error: after 30 min.- 3 x 10^{-6}; after 80 min. - 1 x 10^{-6}

Reference Oscillator
Temperature Effect: ≤1 x 10^{-6}/K
Crystal Aging: ≤1 x 10^{-6}/month

Spectral Purity

	Range	PM 5390S	PM 5390
Harmonics	≤7 dBm	<-30 dB typ.-35 dB	<30dB typ.-35 dB
	to 0 dBm	-30 dB	
	to + 7 dBm	<-25 dB	
	to + 13 dBm	-20 dB	
Non-Harmonics	≥340 MHz	<-40 dB	typ.<-45 dB
	<340 MHz		<-30 dB
Residual FM r.m.s. 0.3-3 kHz (typical)	75 Hz 40 Hz in sub-ranges	75 Hz 40 Hz in sub-ranges	75 Hz 40 Hz in sub-ranges
SSB phase noise distance 20 kHz	-100 dBc/Hz	-100 dBc/Hz	-100 dBc/Hz
Residual AM	typ.<0.5%	typ.<0.5%	typ.<0.5%

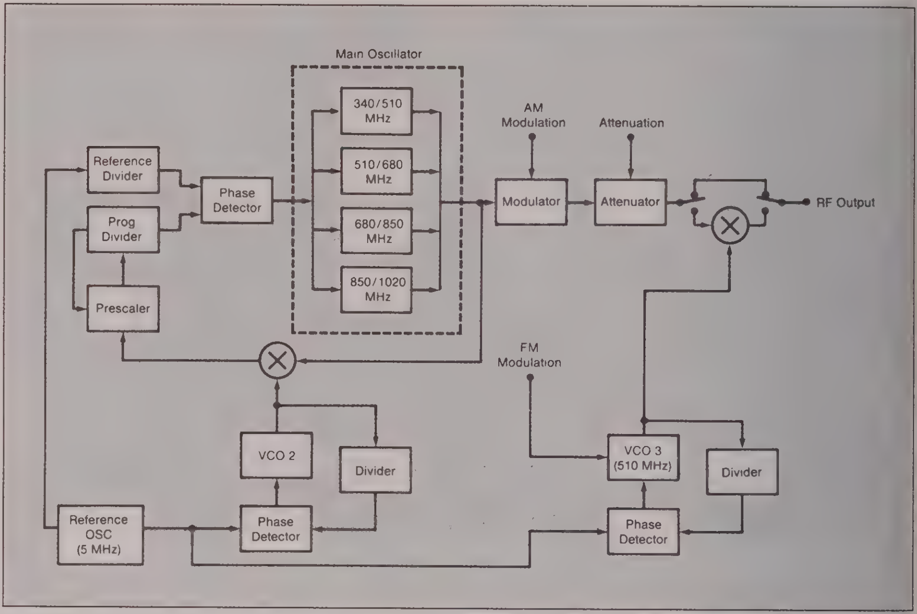
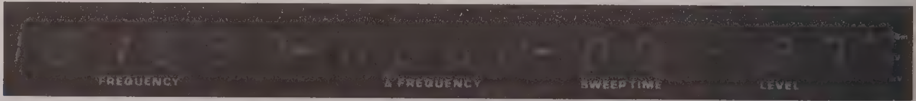
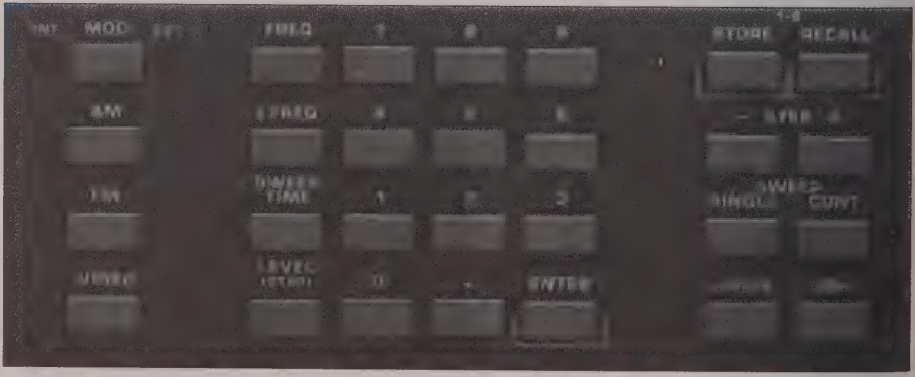


Fig. 1. The PM 5390/90S RF synthesizer functions by mixing frequencies from several oscillators derived from a 5 MHz crystal source.



Detail of the LED panel. The display is subdivided into four parts: 6 digits for the selected RF frequency, (-)4 digits for the incremental frequency, 2 digits for sweep time and 21/2 digits plus polarity indication for the output level.



Detailed view of control panel.

Frequency Increment (Δ FREQUENCY)

Frequency Range: 100 kHz...1019.99 MHz
Increment Range I: 1 kHz...9.999 MHz resolution - 1 kHz
Increment Range II: 10.00...99.99 MHz resolution - 10 kHz
Setting: keyboard, IEEE/IEC bus
Settling Time per Increment: 80...240 ms
Indication: 4 digits, LED

Output Characteristics

RF. Output
Impedance: 50Ω
Output Level (into 50Ω):
PM 5390: -127 dBm to -7 dBm;
PM 5390S: -127 dBm to +13 dBm.
Output Voltage rms (into 50Ω): 0.1 µV...100 mV; 0.1µ...1V
Setting: keyboard, IEEE/IEC bus
Display: 2-1/2 digits, LED
Dimension: dBm, µV, mV, V
Resolution: 1 dB

PM 5390 & PM 5390S

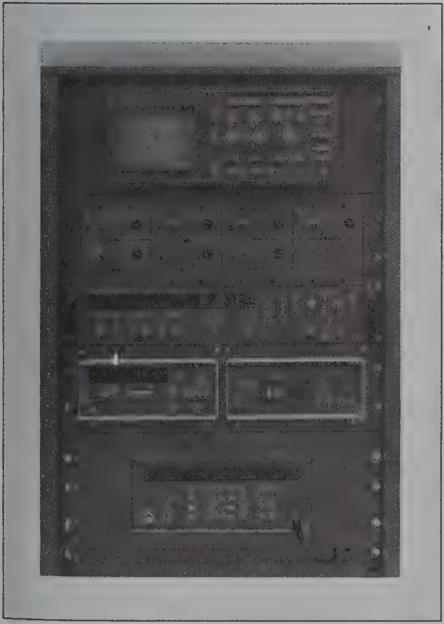
Level Accuracy	PM 5390(S)	Output level
Frequency response	±2 dB	measured at maximum output level
100 kHz-1020 MHz	±1.5 dB typical	
Flatness		
in frequency sub-ranges III, IV, V, VI	0.8 dB	
in frequency sub-ranges I, II	±1 dB	

Attenuation Error per 1 dB step: ±0.3 dB
Additional: ±0.3 dB, ±0.5 dB
Connection: BNC output socket
Load: Short-circuit proof
Max. External Voltage: ±3.5V

Modulation

Modulation Modes: Frequency range
RF Carrier Unmodulated: 100 kHz...1019.99 MHz
Amplitude Modulation, AM: 100 kHz...1019.99 MHz
Frequency Modulation, FM: <340 MHz
Video without Sound Carrier: >30 MHz
Video Sound Carrier AM int/ext.: >30 MHz
Video Sound Carrier FM int/ext.: >30 MHz

Amplitude Modulation, Internal
Modulated Frequency Range: 100 kHz...1019.99 MHz
RF level reduces by 6 dB
Modulation Frequency: 1 kHz, sine wave
Modulation Depth: 30%
Accuracy: ≤5%
Setting: keyboard, IEEE/IEC bus
Indication: LEDs



PM 5390 operating within an automatic testing set up.

Amplitude Modulation, External
Modulated Frequency Range: 100 kHz...1019.99 MHz
RF level reduces by 6 dB
Modulation Frequency: 20 Hz...20 kHz
Modulation Depth: 0-≥80%
Modulation Coefficient: 10 mVp-p/%
Connection: BNC socket
input impedance: 10 kΩ
max. external voltage: ±5V
Setting: keyboard, IEEE/IEC bus
Indication: LEDs

Frequency Modulation, Internal
Modulated Frequency Range: 100 kHz... 339.999 MHz
Modulation Frequency: 1 kHz, sinewave
Deviation: ±25 kHz

Frequency Modulation, External
Bandwidth: 20 Hz...100 kHz
Max. Deviation: ±80 kHz (5...339.999 MHz); ≤± 10 kHz (0.1 MHz-<5 MHz)
Modulation Coefficient: 100 mV/7.5 kHz
Connection: BNC socket
input impedance: 10 kΩ
max. external voltage: ±5V
Setting: keyboard, IEEE/IEC bus
Indication: LEDs

Video

Modulated Frequency Range: 30...1019.99 MHz
Bandwidth: 8 MHz
Amplitude ext. CVBS-Signal: 1 Vp-p into 75Ω
polarity: negative sync. signal
modulation: negative (or positive)
Residual RF Carrier: 15%
Connection: BNC socket
input impedance: 75Ω
max. external voltage: ±5V
Setting: keyboard, IEEE/IEC bus
Indication: LED

Sound

Sound Carrier Internal
Spacing of Vision/Sound Carrier: 5.5 MHz (4.5; 6; 6.5 MHz)
tolerance: <0.2%
Vision/Sound Carrier Ratio: 13 dB
Type of Modulation: FM or AM

Internal Sound Modulation
Modulation Frequency: 1 kHz, sine wave
Deviation: ±40 kHz FM mode
Modulation Depth: 30% AM mode
Setting: keyboard, IEEE/IEC bus
Indication: LEDs

External Sound Modulation
Bandwidth: 50 Hz...20 kHz
Pre-Emphasis: 50µs
Modulation Coefficient FM: 100 mVp-p/8 kHz
Max. Deviation: ±75 kHz
Modulation Coefficient AM: 100 mVp-p/6%
Max. Modulation Depth: 50%
Connection: BNC socket
input impedance: 0.5 MΩ
max. external voltage: ±5V
Indication: LEDs
Setting: keyboard, IEEE/IEC bus
Frequency Sweep: Within a selectable sweep time the frequency passes through a selectable range Δ FREQUENCY in 50 steps from the start frequency (FREQUENCY) to the stop frequency (FREQUENCY + Δ FREQUENCY)
During fly-back the amplitude is reduced.
Frequency Range: 100 kHz...1019.99 MHz
subrange I: 0.1 MHz...169.999 MHz
subrange II: 170 MHz...339.999 MHz
subrange III: 340 MHz...509.999 MHz
subrange IV: 510 MHz...679.999 MHz
subrange V: 680 MHz...849.999 MHz
subrange VI: 850 MHz...1019.99 MHz
Sweep Width: 50 kHz...50 MHz
Step Width: 1 kHz...1 MHz
Number of Frequency Increments per Sweep: 50
Setting: keyboard, IEEE/IEC bus
Indication: 4 digits

Sweep Modes

Single Sweep: Indication - LED
Continuous Sweep: Indication - LED
Sweep Time: 50 ms...20s
resolution: 0.01s...1s
setting: keyboard, IEEE/IEC bus
indication: 2 digits, LED
Flyback Time: 200 ms
Output-Sweep Voltage:

Sweep Time Out

Amplitude: 50 steps of 10 mV each
Impedance: 10 kΩ
Max. External Voltage: ±10V

Storage of Parameter Setting
Memory Locations: 8 complete parameter settings
Storage: Buttons STORE 1...8
Store Time: min. 5 days
Battery: NiCd-cell
Setting: keyboard, IEEE/IEC bus

Remote Control
Conformity: IEEE 488/IEC 625
Connection: 24-pole IEEE bus standard interface
Device Address: Address switch rear side
Remote Indication: LED, remote, front panel
Interface Functions:
AH1 acceptor handshake capabilities
L1 Listener only
RL2 Remote/Local capability
DC1 Device clear capability
Delimiters: Comma, LF (NL + New Line) EXT, ETB
Control Functions: Fully remote controllable

Settling Time
Interface Reaction Time: 2...20 ms typical 5 msec
Frequency Settling Time: 15...120 ms
Level Settling Time: 5 ms

PM 5390 & PM 5390S

General Specifications

Power Requirements

Reference Value: 220V
Nominal Values: 110V/128V/220V/238V, selectable by wiring
Nominal Operating Range: ±10% of selected nominal value
Operating Limits: ±10% of selected nominal value
Nominal Frequency Range: 50/60 Hz tolerance: ±5% of nominal frequency range
Power Consumption: 44W/53W

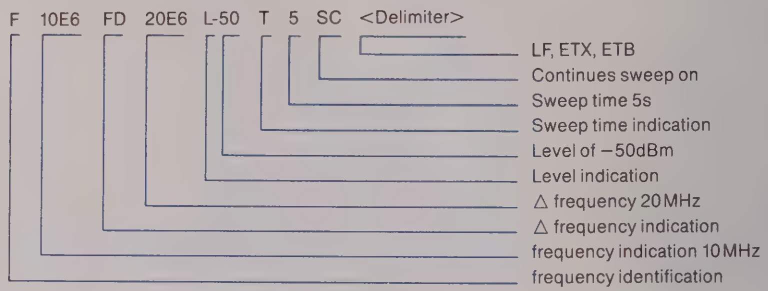
Environmental Capabilities

Ambient Temperature:
Reference Value: +23°C ±1K
Nominal Working Range: +5°C...+40°C
Limits for Storage & Transport: -40°C...+70°C

Cabinet
Protection Type (see DIN 40050): IP 20
Protection Class (see IEC 348): Class I, protective conductor
Line Connection: Mains connector; Shielding; RF-unit double screened
Size: 310 mm W x 140 mm H x 660 mm L (12.2 in W x 5.5 in H x 26 in L)
Weight: 9.9 kg (22 lb)

Included With instrument: Operating manual, power cable (2 meters)

PROGRAMMING EXAMPLE



Ordering Information

Models

January 1989 prices

PM 5390M Programmable 1 GHz RF Generator (-7 dBm output)	$6950
PM 5390SM Programmable 1 GHz RF Generator (+13 dBm output)	7450

Accessories (Also see page 485)

PM 9075 Coaxial Cable BNC-BNC	$11
PM 9585 50Ω Termination, 1W	30
PM 2295/10 IEEE Bus Cable (1 meter)	155
PM 2295/20 IEEE Bus Cable (2 meters)	$170
PM 2296/50 IEEE/IEC Adapter	70
PM 2296/60 IEC/IEEE Adapter	80
PM 9560 19-in Rackmount Adapter	130

Service & Support

Warranty

One-year product warranty. (See page 470 for further information on warranty terms and conditions.)

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

PM 5326

PM 5326

PM 5326 Video RF Signal Generator

- 100 kHz to 125 MHz in 9 overlapping ranges
- 5-digit counter displays, RF-carrier marker and external frequencies to 10^{-4} ±1 digit
- 50 mV RF output at 75Ω can be attenuated to over 100 dB
- Output level electronically stabilized
- Sweep facility for IF amplifiers AM/FM, radio and TV receivers

The RF signal generator PM 5326 has been specially designed for radio and television development laboratories and those involved with receiver sensitivity and selectivity measurements. For service workshops and education the generator also provides four sweep ranges for the alignment of IF amplifiers and FM receivers.

Color Coded Controls

The generator is divided into three functions: main RF oscillator; sweeper; and marker generator. Controls for each function are differently color-coded, being grouped for operator convenience.

Main RF Oscillator

The output frequency extends from 100 kHz to 125 MHz in 9 push-button selected ranges amply covering the domestic AM/FM radio spectrum. A built-in 5-digit display enables frequencies to be easily set to 1 part in 10000, essential for precise alignment procedures, selectivity and filter tests. This counter can also measure frequencies from external oscillators to 999.99 kHz, extendable to 99.999 MHz. Typical uses for the counter include alignment of TV remote control units and checking line and frame time base frequencies.

The output level is electronically stabilized for all ranges eliminating resetting and the need for meter reading and can be continuously attenuated to over 80 dB from the maximum of 50 mV into 75Ω.

This may be set to levels calibrated at -3 dB and -40 dB with a separate attenuator. A particular feature of the generator is the special attention given to spurious RF radiation. A 'double-box' construction gives a high degree of screening, keeping RF radiation very low and ensuring that low level outputs in the region of 0.5 µV can be used with full confidence.

AM/FM Modulation

A choice of CW or MCW output AM or FM and internal or external modulation signals are quickly selected by push-buttons. All AM signals can be internally modulated by a 1 kHz tone to a depth of 30% which is adequate for most applications. This can be increased to 100% over the range 20 Hz to 20 kHz (3 dB) by an external source. Frequency modulation may be applied to the 10/11 MHz and 75-110 MHz ranges allowing complete alignment checks to be made on FM receivers. Internal frequency modulation at 1 kHz is equivalent to a 22.5 kHz deviation. External signals can be applied to a maximum deviation of 75 kHz over the frequency range 20 Hz to 60 kHz (3 dB).

A swept frequency oscillator output is available to measure the dynamic response of intermediate frequency amplifiers in AM/FM and TV receivers. Four frequency ranges are selectable by push-buttons. The maximum sweep widths are 40 kHz for AM/IF, 1.2 MHz for FM/IF and Band II and up to 10 MHz for the video IF ranges. Sweep rate is either by a linear sawtooth between 3-30 Hz or at a line frequency with phase adjustment.

Marker Generator

Markers are available in each RF sweep range to indicate a precise frequency value and provide a calibrated frequency scale over the complete spectrum. The position of the variable marker is controlled by the main frequency control and the setting is displayed on the internal counter. Fixed markers at regular intervals may be added to the output signal by pulling the marker amplitude switch.

Specifications

Technical Specifications

Frequency

Range: 100 kHz...125 MHz
(9 subranges, selectable with push-buttons)
Subranges:
1. 100 kHz...250 kHz
2. 250 kHz...500 kHz
3. 500 kHz...1000 kHz
4. 1 MHz...2.5 MHz
5. 2.5 MHz...5 MHz
6. 5 MHz...10 MHz
7. 10 MHz...25 MHz
8. 25 MHz...50 MHz
9. 50 MHz...125 MHz

Display: 5-digits. 7-segment 11 mm LED.
2-dimension LEDs kHz. MHz
Setting Error: $<10^{-4}$ ±1 digit (typical)
Temperature Coefficient: $<10^{-5}$/K
Short Term Drift: 1 x 10^{-6}

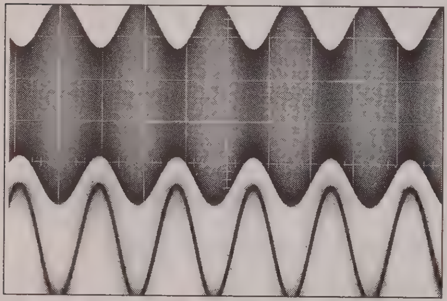
RF Output

Voltage: 50 mV at 75Ω
Impedance: 75Ω
Frequency Response: <2 dB in each RF range (1 dB typical)
Attenuation:
80 dB continuous with indication
40 dB and 3 dB calibrated and switchable

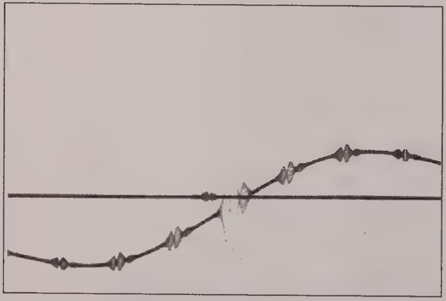
PM 5326

Modulation

Amplitude Modulation: (in all ranges)
Unmodulated
Internal with 1 kHz sinewave (depth 30%)
External with signals 20 Hz...20 kHz (3 dB) (depth 0...100%)
Modulation Coefficient: 200 mV/10% modulation depth
Frequency Modulation:
In ranges 10...11 MHz and 75...110 MHz
Unmodulated
Internal with 1 kHz sinewave (deviation 22.5 kHz)
External with signals 20 Hz...60 kHz (3 dB) (deviation 0...±75 kHz)
Modulation Coefficient: 200 mV/±7.5 kHz deviation
Input: BNC connector MOD/IN
Impedance: >10 kΩ
RF Sweep Ranges:
400 kHz...500 kHz
10 MHz...11 MHz
75 MHz...110 MHz
36 MHz...41 MHz
Frequency Response: >0.2 dB in sweep ranges



Internal AM signal, 1 kHz and 30% modulation depth at a carrier frequency of 27 MHz.

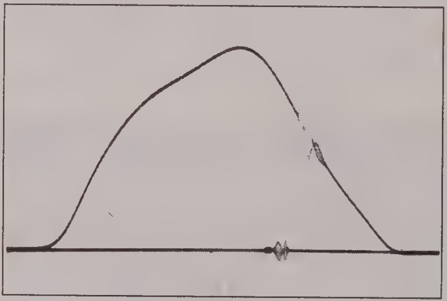


S curve with variable marker at 10.7 MHz and fixed markers at regular intervals of 100 kHz.

Sweep Frequency: 3...30 Hz continuously variable;
50 Hz or 60 Hz mains, phase variable
Sweep Widths: (fully variable)
0...4 kHz in range 400 kHz...500 kHz
0...1.2 MHz in range 10 MHz...11 MHz
0...1.2 MHz in range 75 MHz...110 MHz
0...10 MHz in range 36 MHz...41 MHz
Linearity: >95%
Center Frequency: Fully adjustable between minimum and maximum
Output: BNC connector Sweep out
Voltage: 2...10 Vp-p (varied by internal sweep)
2V at 1 kHz at AM or FM (internal)
Impedance: 1 kΩ

Marker Generator

Fully variable over all four RF sweep ranges and indicated by LED display.
Marker: Marker mixing, AF beat frequency markers
Amplitude: Adjustable to 2 Vp-p
Output: Marker addition via loop through BNC connections Y_{in} - Y_{out}
Impedance: >500 kΩ



The luminance IF curve is aligned at its frequency of 38.9 MHz.

Fixed Markers

Obtained by pulling marker amplitude switch. Distance between the fixed markers dependent on selected range.

Counter (PM 5326X only)

Selected by COUNTER EXT push-button
Input: BNC-connector
Frequency Range: 10 Hz - 999.99 kHz
Input Voltage: 30 mV...50V
Input Impedance: 1 MΩ

General Specifications

Power Requirements

Voltage: 115, 230V
Power Consumption: 18W
Frequency: 48...63 Hz
Size: 310 mm W x 140 mm H x 330 mm L (12.6 in W x 5.5 in H x 13 in L)
Weight: 6.5 kg (14.3 lb)
Included: PM 9537 Cable with impedance transformer 75/300Ω, operating/service manual, line cord.

Ordering Information

Models

January 1989 prices

PM 5326 RF Signal Generator	$2470
PM 5326X As PM 5326 with a counter facility up to 100 MHz	2640

Accessories (Also see page 485)

PM 9072 Cable BNC 4 mm	28
PM 9075 Cable BNC-BNC	11
PM 9560 19-in Rackmount Adapter	130

Service & Support

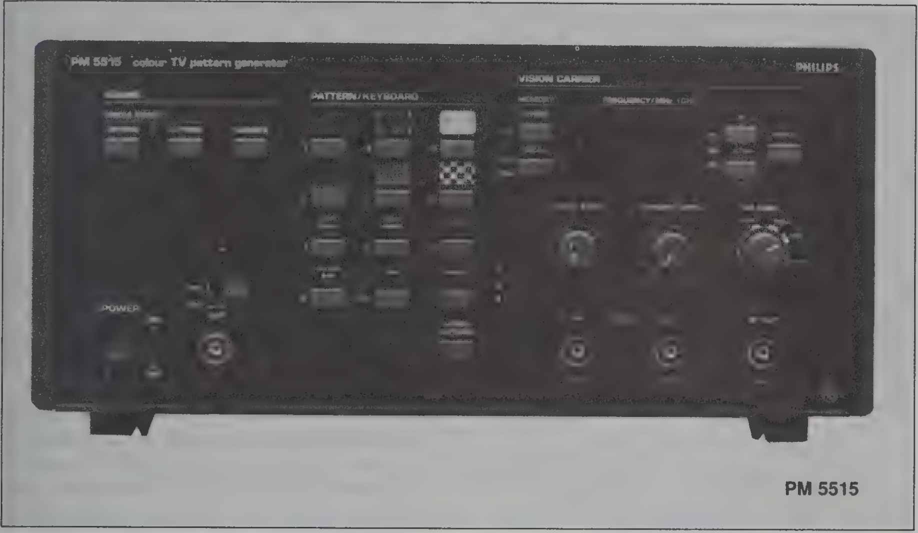
Warranty

One-year product warranty. See Page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 5515, PM 5516 & PM 5518

GPIB
IEEE-488


PM 5515

PM 5515/16/18 Color TV Pattern Generator Family
Synthesized control of RF frequency
Covering every RF band from IF to bands IV/V including cable TV bands
Storage and recall of 10 complete programs, RF freq., pattern and sound settings
Keyboard call-up of up to 70 test patterns/combinations
Simple TV standard selection of PAL, NTSC or SECAM
Operation of up to 3 to 4 receivers on a 10 mV output
RGB option
GPIB/IEEE-488 version with standard RGB and universal chroma

A Pattern for the Future

This family of versatile color pattern generators is designed to cover all available TV standards.

- PM 5515 is for PAL/NTSC
- PM 5516 is for SECAM
- PM 5518 is for SECAM/PAL/NTSC

All models are microcomputer-controlled with powerful, non-volatile memories, allowing predetermined user-programs to be stored and recalled at will. At the touch of a key.

Over 70 different patterns and combinations are achievable, as well as Teletext, FM stereo and dual-channel sound. All very simple to set up.

Each model in the series is available in a basic configuration, and also with enhanced versions to cater to the widest possible spectrum of applications. These are listed at the end of this section. For servicing of color TV monitors and applications involving computer graphics, an RGB option is available. A system version, the TXI, with GPIB/IEEE-488* interface built-in, RGB, and universal chroma as standard, is also available.

Thus many of today's video testing problems are well covered, with reserve capability ready for tomorrow's needs.

Versatility with Ease

The PM 5515/16/18 series offers you unparallelled versatility and ease of use.

Thanks to microcomputer control, one simply keys-in the programs required — R.F. frequency setting, pattern selection and sound modulation. Touch a button to store them — ready for recall. And, even a year later, just recall and the program is still there — ready for immediate use. Versatility plus simplicity.

Lowest Cost of Ownership

Microprocessor control offers more than versatility with ease. It offers security and reliability. Software modules and solid-state memories take over from mechanical switches, reducing service and maintenance costs to the absolute minimum. And with Philips built-in quality and reliability the user enjoys a sound guarantee of low cost of ownership.

An Unparallelled Range

The PM 5515/16/18 series offers an unparallelled range of pattern generators. From the versatile basic model with its touch-button control of every parameter, through models offering FM-stereo and dual sound or Teletext test and page signals, up to the model that offers everything! A range from which one can choose a pattern generator for today — knowing that it will meet tomorrow's needs.

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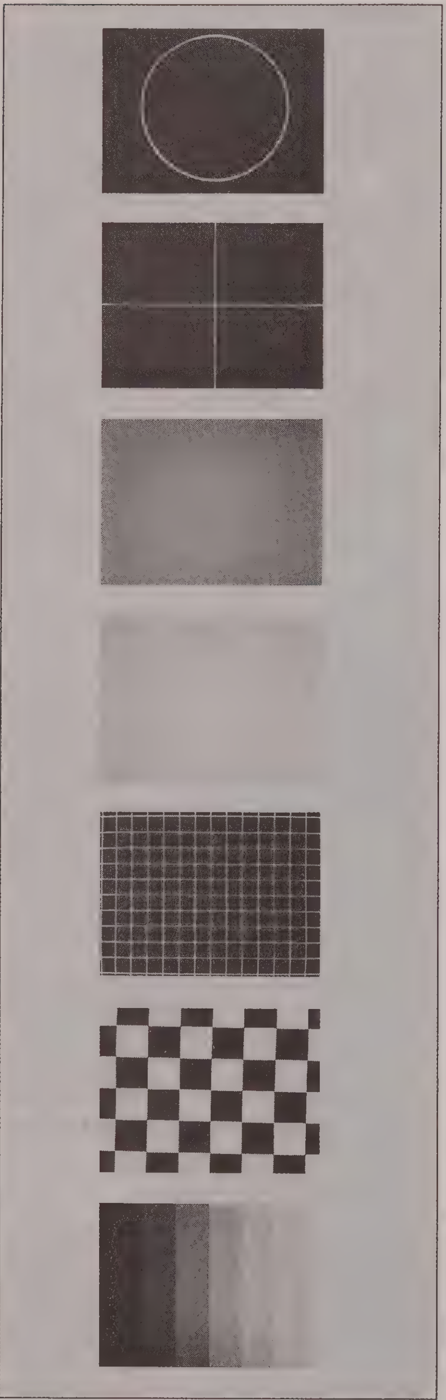
*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

PM 5515, PM 5516 & PM 5518



Patterns for Now and for the Future

Twelve push-buttons make the selection of eighteen different patterns possible. These test patterns check and align the monochrome and chrominance circuitry of the color TV monitors and VCR.

Circle on a grey background for checking the overall linearity and geometry. The white circle changes automatically to black when used with the white pattern and is useful for checking reflections.

Center Cross/Border lines is ideal for centering TV monitors and TV screens. Also to check the deflection linearity and for pin-cushion correction.

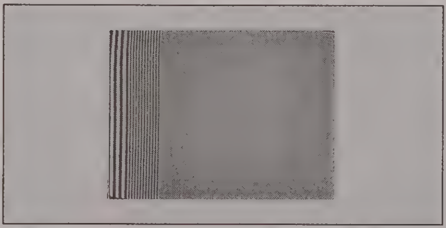
White 100% with swinging burst is designed for setting white D and for an overall check of purity. Also for beam current adjustment. White D is the correct white necessary for a natural color reproduction.

Dot pattern mainly for static convergence. The screen should contain pure white dots.

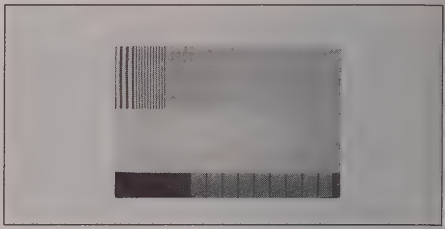
Cross hatch/Center Indication with 17 vertical and 12 horizontal lines is used for checking and re-aligning dynamic and corner convergence. The advantage is that there is no interlacing which would normally tire the eyes. If interlacing is required this can be achieved by superimposing another pattern such as center cross or circle.

Checkerboard pattern of six times eight rows of squares provides a visual standard for basic picture tube alignments, for example: centering, focus, horizontal and vertical deflection and linearity.

Grey scale. Full-screen linear staircase signal with 8 equal steps from black to white is used to locate faulty linearity of the video amplifier or grey-scale setting.



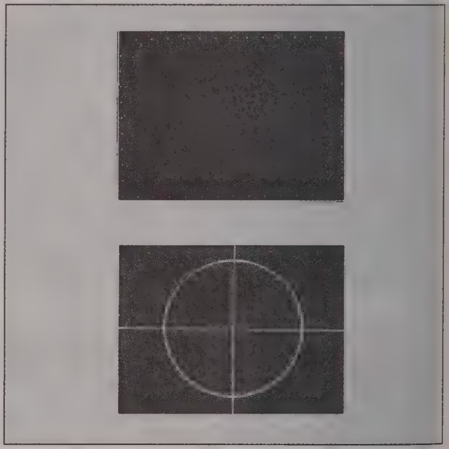
Multiburst contains eight full screen vertical bars of defiinition lines in the frequency ranges 0.8, 1.8, 2.8, 3.0, 3.2, 3.4, 3.8 and 4.8 MHz. This checks the bandwidth of the video or luminance amplifier in black and white or color TV as well as the resolution of monitors and video recorders.



VCR is a specially-designed test pattern to check the bandwidth, linearity, sensitivity and AGC of the chroma amplifiers in color video recorders.

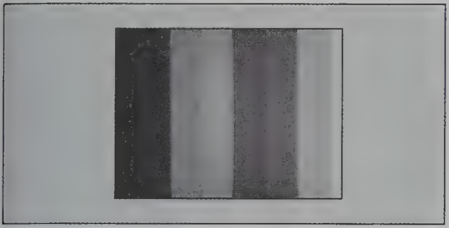
This combined test pattern is divided into 4 horizontal segments:

- 24 lines of 100% white to clip and to level.
- Eight bars of resolution of which 2.8 - 3.0 - 3.2 - 3.4 MHz are used to align the high-pass filter for a maximum resolution in VCR bandwidth.
- Eight steps of decreasing linear levels of saturation from 100 to 0% to check the chroma amplifier linearity and color AGC circuitry.
- A black horizontal bar with a moving white field to check moving pictures on video recorders.



Purity with a choice of the three primary colors clearly indicated by LEDs. The red pattern is used for checking color purity. The green pattern provides a purity check for three-in-line tubes. Blue is also available to check color performance. The three complementary colors, magenta, yellow and cyan can also be displayed by selection, as can white and black.

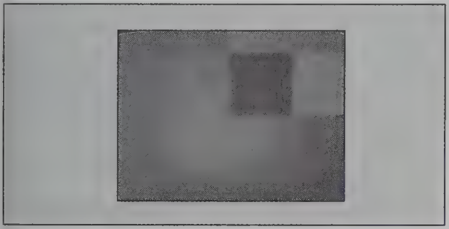
Combinations with circle and/or center cross are easy to select.



Color bar standard bar pattern. The vertical bars are white D, yellow, cyan, green, magenta, red, blue and black.

Since it is dependent on the TV system selected, the luminance content is automatically corrected for each setting.

The color bar pattern therefore provides sufficient information for a good overall check of color performance, including checks on burst keying, subcarrier regeneration, RGB amplifiers, the delay color versus B/W signal and saturation.



Examples of PAL coded DEM pattern. For NTSC this DEM pattern contains different color coding.

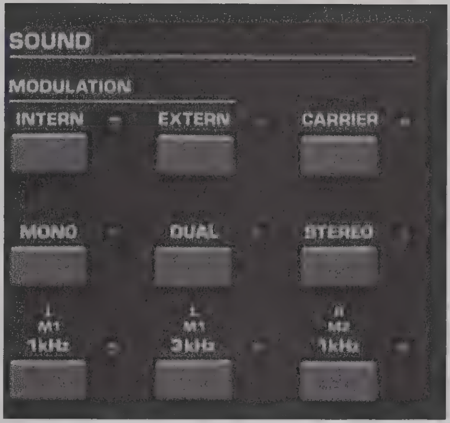
G - Y = 0		Y = 50%	
Δ + (R - Y)	Δ - (R - Y)	◊ + (B - Y)	◊* - (B - Y)
Δ ± (R - Y)	Δ ± (R - Y)	◊ ± (B - Y)	◊** ± (B - Y)
Reference Y = 50%			

Δ (B - Y) = 0 ◊ (R - Y) = 0

* *PAL coded*

** *Anti-PAL coded*

DEM pattern. Demodulator is a combined test pattern which, divided in 4 sections, contains information to make on-screen checks and alignments of the color demodulators and sub-carrier frequency. For PAL it is used to check the chroma delay line for amplitude and phase (venetian blinds). For the NTSC system, the pattern is according to the NTSC requirements and contains 7 color bars, -I and +Q signals and a black and white reference field.



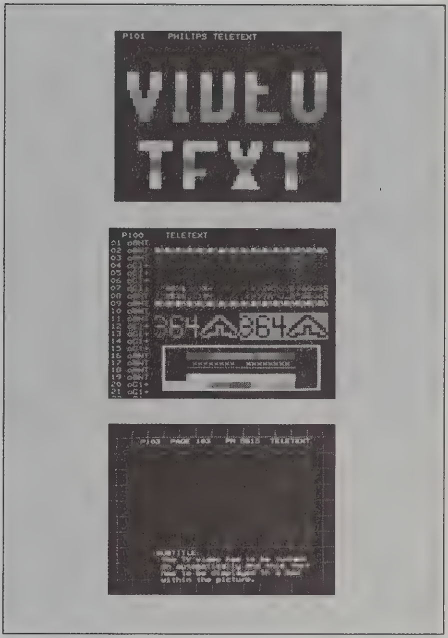
Stereo and Second Sound Channel

For use in standard CCIR, PAL G systems, the PM 5515/16/18 have a selection of optional -X, -TX, and TXS configuarations with two sound carriers — for use in one- and two-channel mode, or right and left channel of a stereo signal. They are therefore appropriate for European systems (and are not compatible with MTS (NTSC) stereo systems).

CTV transmission with stereo sound or alternative second sound channel (e.g. to choose between synchronized or original voice tracks) is becoming more common. The special CTV receivers with stereo decoders needed to reproduce these broadcasts can be expected to be increasingly popular. The -X, -TX and -TXS meet the need for a portable color pattern generator for test and realignment of these receivers.

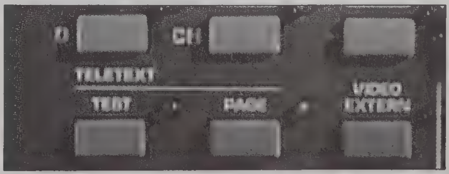
The instrument allows external modulation from a full stereo tuner/amplifier, tape or cassette recorder, with PM 5515 as the RF modulator.

- Sound carriers according to standard at 5.5 MHz and 5.742 187 5 MHz ±3 x 10^{-5}
- Sound/vision separation at 13 and 20 dB, respectively
- Internal FM of 1 kHz and 3 kHz with 30 kHz deviation
- Full external stereo modulation facility for all types of stereo equipment (recorders, CDs, tuners, etc.)
- Pilot tone according to standard at 54.687 5 kHz ±3 x 10^{-5}, with recognition frequencies at $f_H/133+117.5$ Hz (stereo) and $f_H/57+274.1$ Hz (second sound channel)



Teletext

The growth of electronic communications has seen a rapid increase in the introduction of text transmission. To meet the highly specialized requirements for the checking and alignment of teletext receivers and decoders in PAL G and I systems the -T, -TX, and -TXS configurations have been specially developed. Both instruments offer the facility of a selection of five teletext pages with special contents for decoder testing as well as a wallpaper test pattern.



PM 5515, PM 5516 & PM 5518

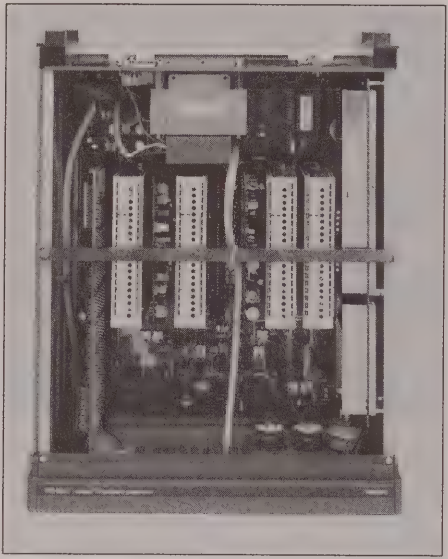
RF Selection

All models cover the full frequency range from 32...900 MHz, including IF and TV transmissions in frequency bands I, III, IV and V. Full coverage of cable TV and S-channels is provided in frequency bands 104...175 MHz (S1...S10) and 230...300 MHz (S11...S20); and hyperband coverage is provided in the frequency range 300...470 MHz. Selection of the synthesized RF frequency within these bands is electronic, via the keyboard.

Up to ten memory places can be used either to store the selected RF frequency or TV channel number. Having stored, e.g. the local TV stations, any one of them can be recalled at the touch of a button without time consuming dial tuning.

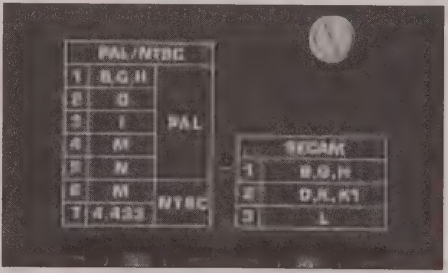
The first digit shows the memory place. The other three digits indicate the selected frequency or TV channel. The RF carrier output of >10 mV into 75Ω is ample for 3 or 4 receivers in parallel during workshop repairs, and the carrier can be continuously attenuated by more than 60 dB, with output indications at 1 mV, 100 µV and 10 µV levels. The ability to smoothly vary the RF level is of particular value when checking the overall RF sensitivity or AGC circuits.

Up to ten memory places can be used either to store the selected RF frequency or TV channel number. Having stored, e.g. the local TV stations, any one of them can be recalled at the touch of a button without time consuming dial tuning.



RF Carrier and Frequency Spectrum

Although double sideband, the RF envelope of the PM 5515/16/18 is very similar to that transmitted by professional TV broadcast companies, such as, e.g., 13 dB for TV standard G between the sound and vision channels. (Most other generators have 25 dB or more separation, leading to false impressions when aligning tuners and RF amplifiers.)



The System Switch

The rear of the instrument offers additional facilities which add to the uniqueness of the PM 5515/16/18 range. A selection switch is used to choose the TV system required. Line frequency is automatically selected utilizing internal, crystals, either 15 625 Hz for CCIR or 15 734 Hz for RTMA with less than 0.4 Hz frequency tolerance.

The correct crystal for color and subcarrier, determining line- and frame-frequencies, is selected automatically.

The Euro/SCART connector for audio/video out as well as the DIN connector for external audio modulation are standard for all models.

Outputs

On the rear panel, video output is via a Euro Scart connector an external sound modulation via a standard DIN plug. Color subcarrier and sync signal are supplied as standard, with RGB optionally available.

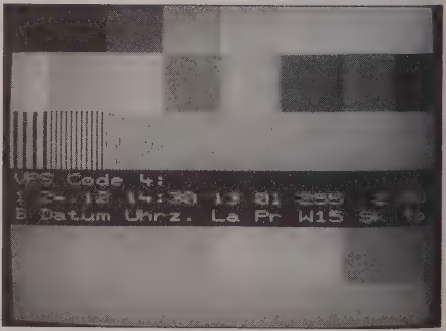
RGB Option

RGB signals and a SYNC and subcarrier facility are available to meet the rapid advance in computer graphics techniques and servicing of color video monitors. There are many monitors which only accept RGB signals and for testing these the RGB option is essential.

VPS Test Facilities

PM 5515-TXS and PM 5518-TXS models offer complete testing of video cassette recorders equipped with VPS, under the PAL B/G/H, D and I/N standards. A maximum of 9 coded VPS signals are available including date, transmission time, country indication, TV channel, stereo/dual/mono sound and adult/general suitability.

Special signals such as LEER code, program interrupt and system status can also be selected. VPS data is shown in a 1/6 screen height horizontal bar which can be combined with any test pattern and displayed in six positions, either on- or off-screen. Unique to VPS instruments is on-screen display of codes and programming the generator to set codes locally if required.



PM 5515, PM 5516 & PM 5518

PM 5518 TXS

A Range for Today and Tomorrow

The versatility of the Philips color pattern generator family not only ensures that today's requirements are expertly met but the developments of tomorrow are anticipated.

PM 5515 Generator For PAL/NTSC

The standard PM 5515 generator with its advanced features, unrivalled in the market place, is complemented by four enhanced models:

PM 5515-T has 5 Teletext pages plus a wallpaper test pattern for aligning and testing teletext receivers and decoders.

PM 5515-X features full additional FM stereo and dual sound channel facilities according to system G.

PM 5515-TX offers, in addition to all the facilities of the basic model, all those features provided by the other two models.

PM 5515-TXS further expands on the -TX version by adding VPS for PAL system G.

PM 5516 Generator For SECAM

The PM 5516 offers the same features as the standard PM 5515 above, except it operates according to the French SECAM TV system L with positive video modulation and AM sound. It also operates to the TV standards D, K1, B, G and H corresponding to OIRT TV system with negative video modulation and FM sound. The desired TV standard is simply selected at the rear of the instrument.

PM 5516 is the standard SECAM COLOR generator.

PM 5516-T is as PM 5516 but extended with ANTIOPE.

PM 5518 Generator For SECAM/ PAL/NTSC and GPIB/IEEE-488 Systems

The PM 5518 expands on the basic PM 5515 by supporting not only the NTSC and PAL TV standards, but also SECAM. In addition, it adds IEEE-488 compatibility as an optional configuration for systems application. As such, it is Philips' most advanced color pattern generator.

A push-button on the front panel selects PAL or SECAM, with a rear panel switch to select NTSC.

In addition to the standard PM 5518, enhanced versions include:

PM 5518-TX operates according to TV standard G, STEREO FM, DUAL SOUND and five pages of teletext and — according to system SECAM L — seven pages of ANTIOPE.

PM 5518-TXS further expands on the -TX by adding VPS for TV standard G.

PM 5518-TXI is the highest performance configuration, specifically aimed at systems applications. In addition to including all of the same features as the -TX by version, it includes RGB, and an IEEE- interface, with "Identification mode" and "Learn mode", plus universal chroma facilities and optional VPS. High stability oscillators are standard for systems use.

These versions offer the same wide choice of test patterns, advanced RF selection, STORE/ RECALL facilities and, last but not least, RGB option, as the PM 5515 PAL/NTSC generators.

PAL and NTSC TV Systems Specifications For PM 5515 and PM 5518

Series	B, G & H	D	I	M	N	M
TV and chroma standard	CCIR, PAL	CCIR, PAL	CCIR, PAL	RTMA, NTSC	CCIR, PAL	RTMA, PAL
No. of lines per picture frame	625	625	625	525	625	525
Field frequency (Hz)	50	50	50	60	50	60
Line frequency (lines/second)	15625	15625	15625	15734	15625	15734
Chrominance subcarrier (MHz)	4.433619	4.433619	4.433619	3.579545	3.582056	3.575611
Sound carrier to vision carrier (MHz)	5.5	6.5	6	4.5	4.5	4.5
Sound modulation	FM	FM	FM	FM	FM	FM
Pre-emphasis (µs)	50	50	50	75	75	75

SECAM TV System Specifications For PM 5516 and PM 5518

TV systems	SECAM B, G, H	SECAM D, K, K1	SECAM L
Sound carrier relative to vision carrier (Hz)	5,500,000	6,500,000	6,500,000
Type and polarity of video modulation	A3F neg.	A3F neg.	A3F pos.
Type of sound modulation	FM	FM	FM
Chrominance subcarrier (Hz)	F_{OB} = 4,250,000 F_{OR} = 4,406,250		
Type of chrominance subcarrier modulation	Frequency modulation		
Transmitted chrominance information	Line sequential D'R and D'B		
Line frequency (lines/second)	15,625		
Field frequency (Hz) (fields/second)	50 (50)		

Specifications

Technical Specifications

Video Carrier

Frequency
Range: 32...900 MHz
IF = Band I: 32...90 MHz
S-Band S1-S10: 104...174 MHz
Band III: 174...230 MHz
S-Band S11-S20: 230...300 MHz
Hyperband H21-H40: 300...470 MHz
Band IV-V: 470...900 MHz
Frequency Selection: Keyboard
Fine Tuning: 250 kHz steps for TV frequencies 100 kHz steps for IF frequencies (32...44.9 MHz)
Frequency Tuning: In positive or negative direction. Tuning speed increase by holding step button
Storage:
a) Possibility for 10 different RF frequencies
b) As a), indicated as TV channel numbers
Indication: 4-digit 7-segment LED display
a) First digit: memory, store and recall position 0...9
b) 2nd, 3rd and 4th digits: 3-digit indication of frequency in MHz. Separate indication for 250 kHz, 500 kHz and 750 kHz steps

PM 5515, PM 5516 & PM 5518

c) Keyboard-selectable TV channel numbers (e.g. C21 or C70)

RF Output

RF Output: BNC connector (front panel)
Impedance: 75Ω
Output Voltage: <10 mV
Attenuation: 60 dB, continuous

Video

Video Modulation
Modulation: AM internal-external switchable
Polarity: Negative/positive for SECAM L
Video Input
Video Input: BNC connector (front panel)
Input Voltage (PP): 1V
Max. permissible:
Input Voltage: ±5V
Impedance: 75Ω
Polarity: White level positive
Coupling: DC (clamping on sync.)

Video Output

Video Output:
a) BNC connector
b) SCART connector (Euro-AV connector), pin 19 (rear)
Impedance: 75Ω
Voltage (PP):
a) 1V fixed
b) Variable between 0...1.5V/75Ω
Polarity: Negative
Coupling: DC

Chroma (PAL and NTSC)

Chroma Standards: PAL according to system B, D, G, H, I, (M, N)
NTSC according to system M (switchable)
Selection: Rear panel thumbwheel system switch
Sub-Carrier Frequency: 4.433619 MHz for PAL B, D, G, H, I;
3.575611 MHz for PAL M;
3.582056 MHz for PAL N;
3.579545 MHz for NTSC
Sub-carrier frequencies coupled to line frequency according to selected standard
Tolerance: ≤3 x 10^{-5} (+5...+40°C)
Burst: Position, number of cycles and phase according to selected standard
Amplitude: Chroma with burst
a) Fixed (100%)
b) Continuously variable from 0...150%
Chroma Vectors Inaccuracy: Phase ≤3°, amplitude ≤5% relative to luminance amplitude

Chroma (PAL/NTSC; PM 5518TXI)

Chroma Standards: As PM 5518 TXS with PAL M, N as standard
Sub Carrier Frequency (coupled with line frequency):

PAL B, D, G, H, I	4.433619 MHz
PAL M	3.575611 MHz
PAL N	3.582056 MHz

Tolerance: 10^{-6}
Temperature Coefficient: 2 x 10^{-6}/K
Ageing: 2 x 10^{-6}/year
Sub Carrier Frequency (not coupled with line frequency):
NTSC (4.433 MHz) 4.433619 MHz
Tolerance: <10^{-4} at 23°C
Ageing: 2 x 10^{-6}/K
Sub Carrier Blanking: acc. to system

Chroma (SECAM)

Chroma standards: SECAM B, G, H, D, K, K1 and L
Selection: Two rear panel thumbwheel system switches
Sound Carrier Rel. to Vision Carrier (Hz): B, G, H-5,500,000; D, K, K1, L-6,500,000
Type/Polarity of Video Modulation: 3 AF/neg.
Type of Sound Modulation: FM
Chrominance Sub-Carrier (Hz): f^{OB} = 4,250,000 f^{OR} = 4,406,250
Tolerance: <2 kHz
Type of Chrominance Sub-Carrier Modulation: Frequency modulation
Transmitted Chrominance Information: Line-sequential D'R and D'B
Line Frequency: 15,625 lines/s
Field Frequency: 50 Hz (50 fields/s)
Signals: D'R = -1.9 (E'R - E'Y)
D'B = 1.5 (E'B - E'Y)
Identification: According to TV system in line and frame
Frame Identification: Position in lines 7 to 15; in 1st, 3rd and 5th field etc.: in lines 320 to 328; in 2nd, 4th and 6th field etc.
Line Identification: By burst (chrominance subcarrier reference signal) on the back porch according to TV standard (B, D, G, H, K, K1, L/SECAM)
Amplitude: Line and frame identificationaccording to TV standard, but also variable between 0...150% together with chroma information
Chrominance Signal: According to standard, but also variable
Amplitude: Between 0...150% of the nominal value
Frequency Deviation: Of chrominance subcarrier according to TV standard
Video Pre-Emphasis: Low frequency pre-correction and high-frequency bell filter according to TV standard
Bell Center Frequency: 4.286 MHz
Tolerances: ≤20 kHz

Chroma (SECAM); PM 5518TXI as above except:

Tolerance: <10^{-6}
Temperature Coefficient: 2 x 10^{-6}/K
Ageing: 2 x 10^{-6}/year

Synchronization

Line Frequency: 15,625 Hz (CCIR), 15,734 Hz (RTMA)
Frequency Tolerance: 0.4 Hz (+5 ... +40°C)
Number of Lines: 625 (CCIR), 525 (RTMA)
Field Frequency: 50 Hz (CCIR), 60 Hz (RTMA)
Line and Frame Sync.: According to TV standard, interlacing
Output: BNC connector (front panel)
Sync. Signal: Combined signal with line and field synchronization pulses with amplitude difference
Voltage (open-circuit): 2.6V for line pulse 5.0V for field pulse
Impedance: 6 kΩ
Polarity: Negative

Sound Carrier and Modulation

Sound Carrier (mono): On/off switchable
Frequency: 4.5 MHz, standard M, N;
5.5 MHz, standard B, G, H;
6.0 MHz, standard I;
6.5 MHz, standard D, SECAM L
Tolerance: ≤3 x 10^{-5} (+5...+40°C)
Vision/Sound Carrier Ratio:
13 dB, standard B, G, H;
11 dB, standard D, K, K1, L;
13 dB, standard M, N;
12 dB, standard I
Sound Modulation: FM, internal and external on/off switchable, AM for SECAM L
Pre-Emphasis: 50 µs, standard B, D, G, H, I, K, K1; 75 µs, standard M, N

Internal

Frequency Deviation:
±30 kHz, standard B, G, H;
±15 kHz, standard M, N;
±27.5 kHz, standard I;
±24 kHz, standard D, K, K1
Modulation Depth: 50%, standard SECAM L

External

0.4V will give the same deviation or modulation depth as with internal modulation
Input: DIN connector, pin 3 + 5 (rear panel)
Impedance: 0.5 MΩ
Bandwidth: 40 Hz...15 kHz
Max Input Voltage: ±40V
Output: SCART connector (Euro-AV connector), pin 3 (rear panel)
Impedance: 1 kΩ
Voltage: 0.4V

Teletext for T and TX Versions

Data Synchronization Frequency:
PAL BGI-6.9375 MHz, ~444 x f^{H};
SECAM L-6.203125 MHz, ~397 x f^{H}
Data Coding: Acc. to standards as PAL
Signal Levels: '1' + 66% level, 0+black level; '1' + 100% White level as PAL
Signal Shaping: Cos_2 filter

Text Data

Decoder Alignment: No combination possible with test alignment patterns only PM 5515T and PM 5516T
Data Contents: Clock run-in standard, framing code standard, full field, remaining pattern pseudo-random (not PM 5518)
Normal Working Mode: Combinations possible with all test patterns

PM 5515, PM 5516 & PM 5518

Data Lines: 22; 335
Data Contents: ≥5 text pages with special contents for decoder testing for each standard

Signal Output

Teletext Signal Combined with Video Signal: Video output
Modulated RF Signal: RF output, RF from basic unit

For X and TX Versions, Sound Section for Stereo and Second Sound Channel Transmission

Standards: B, G
Sound Carriers: Carrier 1-5.5 MHz; Carrier 2-5.7421875 MHz
Vision Sound Carrier Ratio: Carrier 1-13 dB; Carrier 2-20 dB
Frequency Tolerance: <3 x 10^{-5} (+5...+40°C)

Modulation

FM, internal and external on/off switchable
Pre-Emphasis: 50 µs

Internal Modulation

Sound Channel 1: 1 kHz on/off switchable; 3 kHz on/off switchable
Deviation: ±30 kHz in mono/dual-channel
±15 kHz in stereo, right channel switched off
±30 kHz in stereo, left and right channels switched on with 1 kHz internal signal
Sound Channel 2: 1 kHz, on/off switchable
Deviation: ±30 kHz

External Modulation

Sound Channels 1 & 2 Input Voltage: 0.4V will give the same deviation as the internal signal

Inputs

DIN connector (rear panel)
Contacts: Pin 2 (ground), pin 3 sound channel 1, pin 5 sound channel 2
Impedance: 0.5 MΩ
Bandwidth: 40 Hz...15 kHz
Max. Permissible Voltage: +40V

Outputs

SCART connector (Euro-AV connector)
Contacts: Pin 3 sound channel 1, pin 1 sound channel 2
Impedance: 1 kΩ
Voltage: 0.4V

IEEE-488 Interface (PM 5518TXI only)

Allows selection and control of all functions

Operating Mode Detection

Pilot Frequency: 54.6875 kHz (3.5 x f_{line})
Tolerance: <3 x 10^{-5} (+5...+40°C)
Modulation: AM
Modulation Depth: 50%
Identification Frequencies: 117.5 Hz (f_{line}/133) stereo mode;
274.1 Hz (f_{line}/57) dual-channel mode
Deviation of 2nd Sound Carrier: ±2.5 kHz by modulation of carrier with unmodulated pilot
For standards D, I, M, N the stereo versions X and TX also offer all mono facilities.

VPS for TXS Versions

VPS Video Programming System for pre-programmed recording with home video recorders according to German broadcasting organizations ARD, ZDF and ZVEI

Data Synchronization Frequency: 5 MHz
Bit Length: 400 ns
Modulation: Bi-phase modulation
Data Coding: According to the guideline issued by ARD, ZDF and ZVEI
Signal Levels: '0' = black level, '1' = 71.4% of white level
Signal Shaping: Cos$_2$ filter
Location of Data: Line 16
Data Contents: 9 different freely programmable non-volatile sets of VPS data preset at factory; each with 15 words (8 bits), including clock run-in, special identification and date of transmission
Normal Operating Mode: Combination possible with all test patterns and teletext; on/off switchable
Programming: Via keyboard and text strip inserted in the test pattern
Text Strip: 6 different positions, or not visible

RGB Option

RGB Outputs
BNC connectors (rear panel)
Output Voltage (PP): 0.7V/75Ω
Impedance: 75Ω
Sub-Carrier Output
BNC connector (rear panel)
Output Voltage (PP): 1V/75Ω
Impedance: 75Ω
Sync. Output
BNC connector (rear panel)
Output Voltage (PP): 2V/75Ω
Impedance: 75Ω

Universal PAL/NTSC Chroma Molule

PAL Systems: B, D, G, H, I, M, N
NTSC Systems: M

Optional Configuration Performance Table

	TV System													
Model Number	**NTSC**	**PAL**					**SECAM**						**RGB**	**IEEE 488**
	M	**D**	**G**	**I**	**M**	**N**	**L**	**B**	**D**	**G**	**H**	**K1**		
PM 5515	a	a	a	a	a, opt.	a, opt.							opt.	
PM 5515X	a	a	a, b										opt.	
PM 5515-T	a	a	a, c	a, c									opt.	
PM 5515-TX	a	a	a, b, c	a									opt.	
PM 5515-TXS		a	a, b c, d											
PM 5516							a	a	a	a	a	a	opt.	
PM 5516-T							a, e	a	a	a	a	a	opt.	
PM 5518	a	a	a	a	a, opt.	a, opt.	a	a	a	a	a	a	opt.	
PM 5518-TX	a	a	a, b, c	a, c			a, e	a	a	a	a	a	opt.	
PM 5518-TXS	a	a	a, b c, d	a, c			a, e	a	a	a	a	a	opt.	
PM 5518-TXI	a	a	a, b, c d, opt.	a, c	a	a	a, e	a	a	a	a	a	std.	std.

a. Mono sound *b. Stereo sound* *c. Teletext* *d. VPS* *e. antiope-teletext*

PM 5515, PM 5516 & PM 5518

Sub-Carrier Frequency (coupled with line frequency):

PAL B, D, G, H, I	4.433619 MHz
PAL M	3.575611 MHz
PAL N	3.582056 MHz
NTSC	3.579545 MHz

Sub-Carrier Frequency (not coupled to line frequency):

NTSC (4.433 MHz)	4.433619 MHz

Tolerance: <100 x 10^{-6} at 23°C
Sub-Carrier Blanking: According to system

Hyperband Module (only for instruments made before 1987)

Total Frequency Range: 32...900 MHz
IF + Band I: 32...104 MHz
S-Band S1 - S10: 104...174 MHz
Band III: 174...230 MHz
S-Band S11 - S20: 230...300 MHz
Hyperband H21 - H40: 300...470 MHz
Bands IV-V: 470...900 MHz

General Specifications

Power Supply

Voltage: 100, 120, 220, 240 V -12/+10%
Frequency: 50/60 Hz ±5%
Power Consumption: Depends on version
Dimensions: 300mm W x 14mm H x 395mm L
Weight: Approx. 10 kg depending on version
Included: PM 9538 RF cable, BNC TV connector 758, mains cable, operating manual

Ordering Information

Models

	January 1989 prices
PM 5515MM PAL/NTSC Pattern Generator	$1900
PM 5518 NTSC/PAL/SECAML Pattern Generator	$2395

Optional Configurations*

PM 5515MM+RGB Standard PM 5515MM plus RGB; PAL/NTSC	2200
PM 5515+GX Standard PM 5515MM plus PAL G stereo	2500
PM 5515X+RGB Same, plus RGB	2900
PM 5515+GT Standard PM 5515MM plus PAL G teletext	2500
PM 5515GT+RGB Same, plus RGB	2900
PM 5515+GTX Standard PM 5515MM plus PAL G stereo and teletext	2825
PM 5515GTX+RGB Same, plus RGB	3225
PM 5515+TXS Standard PM 5515MM plus PAL G stereo, teletext, and VPS	3425
PM 5515TXS+RGB Same, plus RGB	3725
PM 5518+RGB Standard PM 5518, plus RGB	2695
PM 5518TX Standard PM 5518 plus PAL G stereo, PAL G/I teletext, and SECAM L antiope	3450
PM 5518TX+RGB Same, plus RGB	3850
PM 5518TXS Standard PM 5518 plus PAL G stereo and VPS, PAL G/I teletext, and SECAM L antiope	4050
PM 5518TXS+RGB Same, plus RGB	4450
PM 5518TXI Standard PM 5518 plus PAL G stereo, PAL G/I teletext SECAM L antiope, Universal Chroma RGB and IEEE-488	5150

**For additional models configured for use outside N. America (including the PM 5516), contact factory*

Accessories (Also see page 485)

PM 9539/01 RF cable and 300Ω trafo	30
PM 9075 75Ω BNC-BNC Cable	11
PM 9561 19-inch Rackmount Unit	130

Options (for existing units)

PM 9546 Universal Chroma Unit	220
PM 9545* Hyperband Module	550
PM 9544** VPS Module	650
PM 9543 RGB Output	350

** Replacement unit only for older models; hyperband is now standard on all current models*

*** See VPS for TXS on previous page for specifications Note: All options must be installed by the Philips service department*

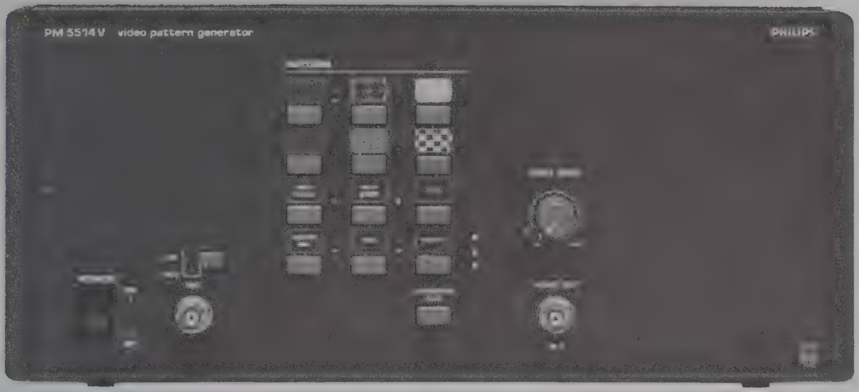
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 5514V



PM 5514V

PM 5514V Video Color Pattern Generators

- Economical video testing
- Over 70 color and monochrome pattterns and combinations
- Simple to operate

PM 5514V for Monitor Testing

The economical PM 5514V is the ideal solution for workshops handling large volumes of computer or CCTV monitors.

It offers a choice of over 70 color patterns and combinations, together with simple and secure microprocessor-controlled operation. All you need to do is connect the CCTV or monitor to be tested, key-in the required test pattern, and check that the TV or monitor performance is correct.

The selected settings are clearly indicated by LEDs next to the pushbuttons. Setting-up couldn't be quicker or more convenient, giving you exactly the test pattern you want, in only a few seconds.

A front-panel CVBS output is standard, and an additional rear-panel RGB output is available as a factory-fitted option. The RGB output includes SYNC and sub-carrier signals, to meet the specific requirements of color monitors and other video equipment. Since many monitors accept only RGB signals, this will in many cases be an essential testing facility. (RF carrier and sound sections, for TV, excluded; see PM 5515 if required.)

A choice of models is available for NTSC M, or for PAL B, G, I or D standards.

Every Pattern You Need — at the Touch of a Button

Twelve push-buttons make the selection of eighteen different test patterns possible. These patterns can be used for checking and aligning the monochrome and chrominance sections of color TVs, monitors and VCRs.

Patterns and uses include:

- **Circle** — for linearity and geometry.
- **Center cross/Border lines** — centering and pin-cushion correction.
- **White** — 'White D', purity and beam current adjustment.
- **Dot pattern** — static convergence.
- **Cross hatch/Center indication** — dynamic and corner convergence, centering.
- **Checkerboard pattern** — useful for basic alignments.
- **Grey scale** (8 step) — video amplifier linearity.
- **Multiburst** (8 bars of definition lines) — video bandwidth and resolution.
- **VCR** — specially designed for checking bandwidth, linearity, sensitivity and AGC of chroma amplifiers in VCRs.
- **Color bar** — overall color performance checks
- **DEM pattern** — color demodulator and sub-carrier frequency checks.
- **Purity** (3 primary colors and combinations) — purity checks

Specifications

Technical Specifications

Video

Modulation
Modulation Type: AM internal
Polarity: Negative
RF Sync. Level: 100%
Video Output
Output Connection:
a) BNC connector
b) SCART (Euro AV) connector pin 19 (rear)
b) Variable between 0...1.5V into 75Ω
Impedance: 75Ω
Voltage (P-P):
a) 1V fixed
b) Variable between 0...1.5V into 75Ω
Polarity: Negative
Coupling: DC

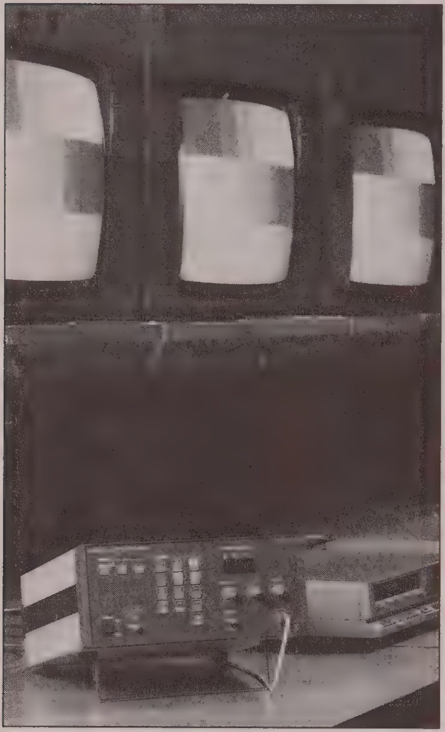
Chroma

Chroma Standard: PAL, B, G, H, I and D, or NTSC M (fixed for each instrument; not switchable)
Sub-Carrier Frequency: 4.433 619 MHz for standard B, G, H, I;
3.579 545 MHz for standard M NTSC
Both coupled to line frequency
Tolerance: <3 x 10^{-5} (+5...+40°C)
Burst: Position, number of cycles according to standard
Amplitude: Chroma with burst, fixed 100%, on/off switchable
Chroma Vectors Inaccuracy:
Phase: ≤3°
Amplitude: ≤5% relative to luminance amplitude

Sound Carrier and Modulation

Sound Carrier Mono: On/off switchable
Frequency: 5.5 MHz, standard B, G, H;
6.0 MHz, standard I;
6.5 MHz, standard D
Tolerance: <3 x 10-5 (+5...+40°C)
Vision/Sound Carrier Ratio: 13 dB, standard B, G, H, D; 12 dB, standard I
Sound Modulation: RM internal/external on/ off switchable
Pre-Emphasis: 50 µs
Internal: Frequency deviation
±30 kHz, standard B, G, H
±27 kHz, standard I
±24 kHz, standard D
External:0.4V gives the same deviation as with internal modulation
Input: DIN connector pins 3 & 5 (rear panel)
Impedance: 0.5 MΩ
Bandwidth: 40 Hz...15 kHz
Max. Input Voltage: ±40V
Output: SCART (Duro AV) connector, pin 3 (rear panel)
Impedance: 1 kΩ
Voltage: 0.4V

PM 5514V



Synchronization

Line Frequency: 15 625 Hz for CCIR, 15 734 Hz for RTMA
Number of Lines: 625 for CCIR, 525 for RTMA
Field Frequency: 50 Hz for CCIR, 60 Hz for RTMA
Line + Frame Sync.: According to standard, interlacing
Sync. Signal: Combined signal; line and frame synchronization pulses with amplitude differences
Output: BNC connector (front panel)
Voltage (open circuit): 2.6V for line pulse, 5V for field pulse
Impedance: 6 kΩ
Polarity: Negative

RGB (Optional)

RGB Outputs: BNC connectors (rear)
Output Voltage (pp): 0.7V into 75Ω
Impedance: 75Ω
Subcarrier Output: BNC connector (rear)
Output Voltage (pp): 1V into 75Ω
Impedance: 75Ω
Sync. Output: BNC connector (rear)
Output Voltage (pp): 1V into 75Ω
Impedance: 75Ω

General Specifications

Power Supply

Line Voltage: 110/127V or 220/240V
Tolerance: -12...+10%
Frequency: 50 Hz
Tolerance: 5%
Power Consumption: ≤42W
Dimensions: 300mm W x 140mm H x 395mm L
Weight: 6.5 kg

Included With instrument: Manual, rf output cable (BNC-DIN)

Ordering Information

Models

January 1989 prices

PM 5514VMM Video Pattern Generator; NTSC	$1370
PM 5514VMM RGB Video Pattern Generator with RGB; NTSC	1685

Optional Configurations

Alternate configurations are available for PAL B, G, I or D. Please contact factory for details.

Accessories (Also see page 485)

PM 9539/01 75Ω RF cable with 75Ω/300 Ω impedance transfer	30
PM 9075 75Ω/300 Ω RF cable, BNC-BNC	11
PM 9561 19 inch Rackmount Kit	130
PM 9543 RGB Option	350

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

Counters/Timer Counters

Page 323 PM 6654C

Page 332 PM 6666

Page 348 PM 6676

Page 351 1912A

Whether you use frequency counters or counter/timers, on the bench, in the field, or in automated systems, Fluke and Philips can address your time and frequency measurement needs from economical solutions to state-of-the-art performance.

Fluke and Philips provide the broadest selection of non-microwave counters in the industry. Models range from the 1900A, with a price to suit any budget, to the high performance PM 6654C which offers 15 measuring functions and nine digits of resolution in a one second measuring time. We also offer the PM 6669, the lowest cost IEEE-488 counter available, the PM 6665, the lowest cost IEEE 488 timer/counter available, and the PM 6666 the lowest cost fully programmable IEEE-488 timer/counter available.

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Systems Counter/Timers 323
Benchtop Timer/Counters 334
Multifunction Counters 348
Frequency Only Counters 359

Counters/Timer Counters

Selection Guide

Model	Frequency Range	Max. Display Digits	Best Sensitivity	High Resolution Computing Counting	Frequency Period Ratio Totalizing	Single Shot Time Interval Resolution	Phase	RPM	Pulse Width	Freq. Burst	Volt Max/ Min.	Page No.
Systems Timer/Counters												
PM 6666	120 MHz/1.1 GHz	9	10 mV	7 digits/s	•	100 ns					•	334
PM 6652C	120 MHz/1.5 GHz	9½	20 mV	7 digits/s	•	100 ns	•	•	•	•	•	323
PM 6645C	120 MHz/1.5 GHz	9½	20 mV	9 digits/s	•	2 ns	•	•	•	•	•	323
1953A	125 MHz	9	30 mV		•	100 ns						332
Benchtop Timer/Counters												
PM 6665	120 MHz/1.1 GHz	9	10 mV	7 digits/s	•	100 ns		•				334
7250A	80 MHz	7	10 mV		•	100 ns		(2)				339
7260A	125 MHz/1.3 GHz	8	10 mV		•	100 ns		(2)				339
7261A	125 MHz/1.3 GHz	8	10 mV		•	10 ns		(2)				339
PM 6670	120 MHz	8	10 mV	7 digits/s	•	100 ns	•	•	•			342
PM 6671	120 MHz	8	10 mV	7 digits/s	•	100 ns	•	•	•	•		342
PM 6672	1 GHz	8	10 mV	7 digits/s	•	100 ns	•	•	•	•		342
Multifunction Counters												
1900A	80 MHz	6	25 mV		(3)							364
1910A	125 MHz	7	15 mV		(3)							365
1911A	250 MHz	7	15 mV		(3)							365
1912A	520 MHz	7	15 mV		(3)							365
PM 6669	120 MHz/1.1 GHz	9	10 mV	7 digits/s	•			•	•			355
PM 6673	120 MHz	9	10 mV	7 digits/s	•					•		348
PM 6674	550 MHz	9	10 mV	7 digits/s	•					•		348
PM 6675	600 MHz (dir. gated)	9	5/10 mV	7 digits/s	•					•		348
PM 6676	1.5 GHz	9	10 mV	7 digits/s	•					•		348
Frequency Only Counters												
PM 6667	120 MHz	7	15 mV	7 digits/s								367
PM 6668	1 GHz	7	15 mV	7 digits/s								367
7220A	1.3 GHz	9	10 mV	(1)						•		339

Note 1: Has optional X1000 10 Hz-10 kHz resolution multiplier.
Note 2: Has cpm x 100.
Note 3: Except ratio.

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Selection Guide

Model	Rise-Time, Duty Factor, MATH	Triggering				Options					Page No.
		Adjustable Level Selection	Input Coupling	Hold-Off	External Control (Note 4)	Best Timebase	Battery	Analog Output	IEEE-488 Control		
									Partial	Full	
Systems Timer/Counters											
PM 6666		Auto, Var	ac/dc			MTCXO	•			•	334
PM 6652C	•	Auto, Var	ac/dc	•	•	Oven		•		•	323
PM 6654C	•	Auto, Var	ac/dc	•	•	Oven		•		•	323
1953A		Variable	ac/dc			Oven				•	332
Benchtop Timer/Counters											
PM 6665		Variable	ac/dc			MTCXO	•		•		334
7250A		Variable	ac			Oven	•		•		339
7260A		Variable	ac/dc	•		Oven	•		•		339
7261A		Variable	ac/dc	•		Oven	•		•		339
PM 6670		Variable	ac/dc			Oven	•	•	•		342
PM 6671		Variable	ac/dc	•	•	Oven	•	•	•		342
PM 6672		Variable	ac/dc	•	•	Oven	•	•	•		342
Multifunction Counters											
1900A			ac			RTXO	•				364
1910A			ac			TCXO	•				365
1911A			ac			TCXO	•				365
1912A			ac			TCXO	•				365
PM 6669		Auto, +0-	ac			MTCXO	•		•		355
PM 6673		+0-	ac		•	Oven	•	•	•		348
PM 6674		+0-	ac		•	Oven	•	•	•		348
PM 6675		+0-	ac		•	Oven	•	•	•		348
PM 6676		+0-	ac		•	Oven	•	•	•		348
Frequency Only Counters											
PM 6667		Auto	ac			TCXO	•				367
PM 6668		Auto	ac			TCXO	•				367
7220A			ac			Oven	•		•		339

Note 4: Provides 3 functions: measurement arming control, external reset, and frequency burst averaging.

Introduction

Applications for frequency and time-related measurements vary considerably. Requirements can include high-accuracy frequency calibration of RF signals, frequency measurements on noisy signals, accurate propagation delay measurements, phase shift in filters, high resolution counting on low frequency tone control signals, etc.

The instruments which perform these time-related measurements are generally known as counters. There are quite a number of names for various classes of these products which date back to the era before microprocessors were incorporated into counters. Today, there are two categories of these instruments: frequency counters and timer/counters.

Frequency Counters

A frequency counter has a single input channel, and sometimes an additional prescaled input for measuring high frequencies. The most basic units offer frequency-only measurements. Most counters offer the following functions:

- Frequency
- Period

More versatile instruments also offer:

- Totalizing (Pulse Counting)
- Frequency ratio (relative mode)
- Frequency deviation (relative mode)
- Pulse Width
- RPM (freq x 60)

Typical applications for these products range from high accuracy calibrations of telecommunications equipment (normally in the RF range) down to low-cost frequency indicators for small repair workshops and hobbyists.

Timer/Counters

In addition to the frequency measurements noted above, a timer/counter can also perform time interval measurement between two events (start and stop event). A timer/counter is therefore characterized by its dual and identical input channels, the start and stop channels (usually labeled A and B). A third input channel can be added for prescaled HF frequency measurements. Almost all counter/timers offer the following functions:

- Frequency
- Period
- Time Interval (Channel A to Channel B)
- Frequency Ratio (Channel A/Channel B)
- Totalizing

More advanced models offer a wealth of different functions, with the most common listed below:

- Pulse Width
- Rise/Fall Time
- Voltage Measurements
- Phase Delay (A to B)
- Duty Factor

Fluke and Philips Electronic Counters

Frequency Counters		Timer/Counters	
Frequency-Only Counters	Multi-Function Frequency Counters	Bench-Top Timer/Counters	Systems Timer/Counters
7220A PM 6667 PM 6668	1900A 1910A 1911A 1912A PM 6669 PM 6673 PM 6674 PM 6675 PM 6676	7250A 7260A 7261A PM 6665 PM 6670 PM 6671 PM 6672	1953A PM 6666 PM 6652C PM 6654C

Timer/counters are found in the lab or on the service bench and also in systems. These systems vary from small temporary set-ups to large ATE systems. Consequently, there is a choice between bench top and systems models. Bench top units can be equipped with an IEEE-488 interface, allowing programming of most major functions. Systems units allow programming of all input settings, including trigger level and attenuation.

Optional Accessories

The conditions of use are important. Use in the field, on a laboratory bench or in an automatic test system require different options such as: battery supply, BCD output, analog output (for recording on a strip-chart recorder), GPIB/IEEE-488* bus interface, rack-mount facilities, ultra-high stability oven oscillators, etc.

In selecting a counter, the availability of a wide range of such options is of great importance especially when the type of application may change after some time in use.

Front-end Circuitry Requirements

The requirements for input signal-conditioning when making frequency and time measurements are somewhat contradictory as the following observations will illustrate.

Frequency Counting

Figure 1a shows a sinewave signal crossing the hysteresis band of the input circuit. Each period of the sinewave that crosses the hysteresis band should cause a clean pulse that can be counted by the digital circuitry.

Noise on the sinewave, however, causes the signal to pass through the hysteresis band more than once per sinewave period giving false counts. Figure 1b shows how an expanded hysteresis band can prevent this type of error.

Time Interval Measurement

Figure 2a shows a pulse, the duration of which is to be measured. Triggering at 50% of amplitude should start the time measurement at A and stop it at B.

The hysteresis of the input circuit, however, causes triggering to occur at A1 and B1. The different slopes of leading and trailing edges cause different delays, resulting in a faulty measurement. A very narrow hysteresis band as shown in Figure 2b will reduce these errors.

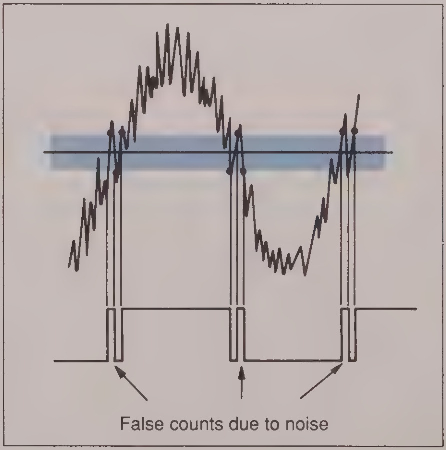

Figure 1a.

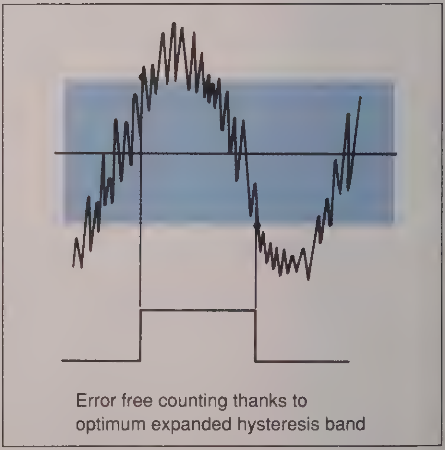
Error free counting thanks to optimum expanded hysteresis band

Figure 1b.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Error-Free Triggering

Figure 1b shows that "error-free" frequency counting is obtained by a wider hysteresis band or, in other words, by an attenuated input signal.

Thus for frequency measurement a continuously variable input attenuator permits optimum matching of the input signal to the counter's trigger sensitivity.

Figure 2b shows that a lower hysteresis voltage will minimize the time measurement error.

Thus a low hysteresis voltage (narrow trigger window) together with a continuously variable trigger level setting permits accurate time interval measurements.

AC-Coupling

Frequency counting on sinewaves or on generally symmetrical signals is best achieved with AC-coupled inputs. AC-coupling has no temperature drift problems, while added DC signal components are eliminated. This assures simple, stable, and thus, reliable triggering.

Frequency counters also need to measure on narrow pulses or other waveforms.

Triggering on any waveform, having any duty factor can be performed by means of a trigger level off-set in the input channel amplifier, see Figure 3.

DC-Coupling

Time interval measurements with accurately set trigger levels, or those that are wave form-independent, require DC-coupling. This might include rise time measurement on a pulse, requiring 10% to 90% level setting, or a pulse duration measurement with accurate setting of trigger levels at 50% of the pulse amplitude.

High Resolution Computing Counting

Measuring Resolution

The controlling and computing power of modern microcomputers enables frequency measurements to be made in the most logical way. The formula for computing frequency is:

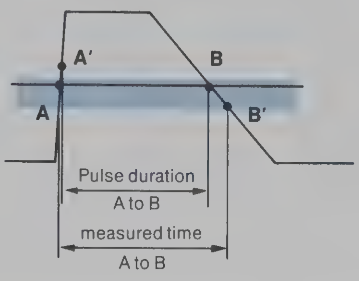
$$\text{Frequency} = \frac{\text{Number of cycles}}{\text{Time}}$$

Modern microcomputer-based frequency counters do precisely that which is given in the frequency definition

1. They count the number of complete input cycles.
2. They measure the effective gate-time, which is the time duration of the totalized number of input cycles.
3. Thereafter, they compute the value of:

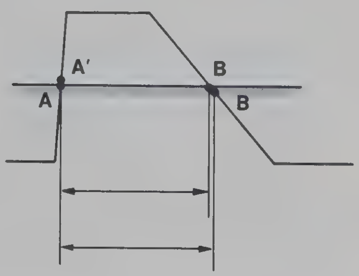
$$\frac{\text{Number of cycles}}{\text{Time}}$$

Finally the microcomputer computes the resolution to define the number of digits to be displayed.



Measured time is too long. The hysteresis causes different delay due to different slopes

Figure 2a.



Greatly reduced trigger error due to very narrow hysteresis band

Figure 2b.

A computing frequency counter contains two counting registers. One counting register counts the number of input cycles, while the other register counts the number of 10 MHz reference clock pulses, to measure the time duration.

The required measuring time can be selected independently and can be varied continuously as well as in fixed steps.

The actual measuring time is synchronized with the input signal and is therefore exactly a multiple of complete cycles. This way, the traditional ±1 input cycle error is avoided. During the same time, the time counter has totalized the number of 100 ns (10^{-7}s) reference clock pulses or 2 ns in the case of PM 6654C. The count error is ± one clock pulse. The total gate-time is the number of clock pulses x 10^{-7}s or x 2×10^{-9}s for the PM 6654C.

To obtain the frequency or period value, only a simple division has to be made.

$$\text{Frequency} = \frac{\text{Counted input cycles}}{\text{Time counts x } 10^{-7}\text{s}^*}$$

$$\text{Period} = \frac{\text{Time counts x } 10^{-7}\text{s}^*}{\text{Counted input cycles}}$$

The ±1 count error is ±100 ns* (10^{-7}s).* The resolution or relative count error is:

$$\text{Rel. resolution} = \frac{\pm 10^{-7}\text{s}^*}{\text{Measuring time}}$$

**For the ultra-high resolution PM 6654C, the figure is 2×10^{-9}s*

Note that the resolution is independent of the frequency value. When measuring, for example, a line frequency with 1s of measuring time, a readout of at least 7 accurate digits e.g., 50.78349 Hz, will result. A conventional counter would in this case only display 2 digits, e.g., 51 Hz. This is because conventional counters are not syn-

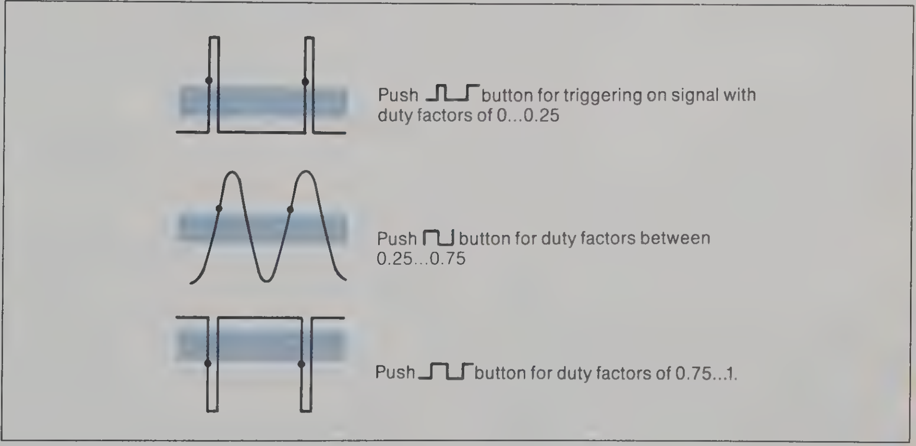

Push ⎍⎍ button for triggering on signal with duty factors of 0...0.25
Push ⊓⊔ button for duty factors between 0.25...0.75
Push ⊔⊔ button for duty factors of 0.75...1.

Figure 3.

chronized with the input signal, but with the internal time base. The ±1 count error is now found in the input cycle counting register, which implies that the resolution for conventional counters is:

$$\text{Rel. resolution} = \frac{\pm 1}{\text{Frequency x gate time}}$$

One obvious advantage with microprocessor-based computing counters is thus the very good resolution even at low frequencies.

Another advantage is the possibility to mathematically process the measuring data such as displaying counts per minute (RPM) instead of counts per second, display phase delay in degrees based on the relative time delay between two signals, etc.

Crystal Oscillators

A counter's maximum accuracy is ultimately limited by its time base reference accuracy.

Depending on the application requirement, most counter models can be ordered with a choice of different crystal oscillator time base options.

The oscillator with the highest available stability (PM 9691), features a stability of 5×10^{-10}/24h, and can be included in the high accuracy counters of the PM 667. and PM 665. Series.

Selection of Time-Base Option

Depending on the application accuracy requirement, operating temperature range and tolerated recalibration interval, a suitable time base selection can be made. As general indication, one can state that the accuracy limitation, caused by the time base is as follows:

No. of Digits	Type of Crystal Oscillator	Option Numbers
5-6	Standard or Uncompensated	Standard or /.1.
6-7	TCXO w/analog Compensation	TCXO, -111, -112, /.2. or PM 9678
7-8	TCXO w/Mathematic Compensation (MTCXO) or Oven Control	MTCXO, -131, -132, -10, -20 or /.3. /.4. or PM 9607, PM 9679, PM 9690
8-9	Ultra High Stability Oven Control	/.5. or PM 9691

Time-Base Inaccuracy (Relative Error):

Timebase error is determined by the summary of the following terms:

$$\frac{\partial f}{F} = \pm \frac{\partial fa}{F} \pm \frac{\partial ft}{F} \pm \frac{\partial fs}{F}; \quad \text{where}$$

∂f : the deviation from the nominal 10 MHz crystal frequency

F : nominal 10 MHz crystal frequency

$\frac{\partial fa}{F}$: relative deviation due to aging

$\frac{\partial ft}{F}$: relative deviation due to temperature changes from calibration temperature

$\frac{\partial fs}{F}$: relative deviation due to supply voltage and/or supply mode variation

PM 6654C & PM 6652C

GPIB
IEEE-488

PM 6654C

PM 6654C & PM 6652C System Timer/Counters

- High accuracy FREQUENCY AND PERIOD measurements of 9 digits in one second
- High sensitivity 1.5 GHz input with wide 10 mV_{RMS}...12 V_{RMS} dynamic range
- TIME-INTERVAL resolution down to 0.5 ps averaged and 2 ns single shot
- Measuring modes incl.: Phase, Rise/Fall Time, Duty Factor, Vmax/min/pp of input
- 8 pre-programmable front panel menus: digital readout of trigger levels
- Mathematical functions
- Trigger facilities include Arming, Hold-Off, Ext. Gating and Auto Trig. Level

Introduction

Philips' PM 6652C and PM 6654C high performance, fully programmable timer/counters satisfy virtually all frequency and time measurement requirements, especially in R & D laboratories and automatic test systems applications.

The measuring functions and appearance of both instruments are the same. The difference is found in resolution, accuracy and measuring speed. The PM 6652C has a 10 MHz (100ns) clock frequency, whereas the extra high resolution PM 6654C features a 500 MHz (2ns) real-time clock resolution. Thus, the PM 6654C's measuring circuitry gives some 50 times better resolution or measuring speed than found in the PM 6652C and in most other counters on the market. Thanks to its short measuring cycle times, the extra high resolution PM 6654C is particularly well suited to high speed automatic test systems. Both the PM 6652C & 6654C timer/counters offer extremely powerful measuring capabilities. With 14 frequency, time and voltage measuring modes, 100% GPIB/IEEE-488* Bus programmability, over 400 readings/second Bus speed, 2ns single shot resolution and 1.5 GHz frequency range, the PM 6654C challenges most other timer/counters.

Voltage Measurements

Both timer/counters offer standard volt measurements: V_{max}, V_{min}, V_{DC}, V_{pp} or even V_{RMS}, whether on LF sinewaves or high speed pulses.

In combination with the time measurements: DUTY FACTOR, PERIOD, PULSE WIDTH, DELAY, RISE-AND-FALL TIME and PHASE, these PULSE VOLTAGE measurements allow automatic test systems to measure pulse and other input parameters, that could only be viewed previously on an oscilloscope.

Powerful FREQUENCY Measuring Capabilities

High accuracy FREQUENCY and PERIOD measurements can be made in a one second measuring time with resolution of 9 digits in the PM 6654C and 7 digits in the economy version PM 6652C. Both models perform advanced frequency measurements, including externally gated frequency measurements, burst frequency and multiple burst frequency average measurements on down to 200ns narrow bursts (500ns for PM 6652C).

Trigger HOLD-OFF, when activated in the FREQUENCY and PERIOD modes, acts as a digital low-pass filter to ignore noise and interference, thereby preventing erroneous measurements.

Mathematics

The MATH (mathematics) facility allows scaling and/or off-setting of measured results before display. This significantly extends the range of application by enabling calibration or unit conversion as in the following examples:

V_{pp} measurements can be converted to V_{RMS}; frequency readings from a transducer can be calibrated as RPM, liters/s, gallons/min or m/s; phase measurements can be converted from degrees to radians and pulse reflections in faulty cables can be directly calibrated for fault location finding in meters of cable length.

The Ultimate in Time Interval Measuring Accuracy

A unique combination of high resolution, high trigger accuracy and special trigger control facilities puts these instruments among the most powerful timers on the market.

The high technology PM 6654C with its 2ns single shot resolution allows time interval measurements to be made to an accuracy and resolution well beyond those of normal timer/counters.

Repetitive signals allow significantly improved resolution by averaging of measuring results. Time intervals, pulse widths, rise and fall times can be measured this way down to sub-picosecond resolution with the PM 6654C and down to 10 ps resolution with the PM 6652C.

Trigger Accuracy

Ultimately, no timer measures more accurately than its trigger accuracy. Therefore high speed/high sensitivity input stages, high trigger level setting accuracy and shortest possible trigger delays. The PM 6652C's and PM 6654C's inputs feature very fast 1 ns rise times and 20 mV_{RMS}, sensitivity over a wide -5V...+5V dynamic range. Trigger level accuracy is assured by the digital setting and readout. At the push of a button, the counter displays, simultaneously, the set trigger

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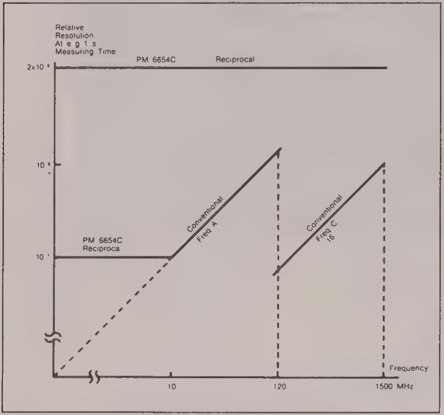
* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 6654C & PM 6652C

levels of both the A and B channels with a 10 mV resolution. Trigger levels may be set by knob controls, keyboard entry, or automatically.



The PM 6654C benefits from the 500 MHz internal clock, by utilizing RECIPROCAL counting for all frequencies.
The PM 6652C selects, automatically, RECIPROCAL or CONVENTIONAL counting in order to achieve the highest possible resolution, for any frequency.

The Actual Trigger Points are Displayed

Automatic hysteresis compensation ensures that the actual triggering occurs at the set trigger level and is not delayed by the input hysteresis. Systematic trigger errors are thus kept to an extremely low level.

Powerful Extra Trigger Controls

The PM 6652C & 6654C provide full control over start and stop triggering. Arming and trigger hold-off enable unwanted signals to be ignored which would otherwise trigger the counter. Arming avoids false starts while a wide range variable trigger hold-off prevents false stops. The set hold-off time can be read on the display.

Designed for Ease-of-Use

For user-convenience, the PM 6652C & 6654C provide superior intelligence. Both counters contain two microprocessors, one to automate the operation and for communication with the front panel, the other for fast measuring control and data handling.

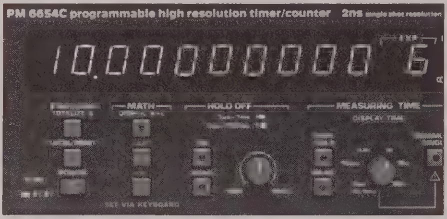
Simple Function Selection

Function selection is achieved by means of only one single control. The up/down function selector with moving cursor in the display window indicates clearly which measuring mode is selected. See figure on following page.

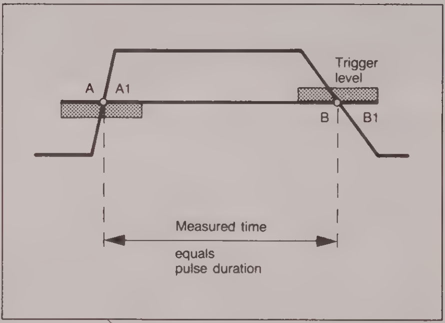
Stored Front Panel 'Menus' P1...P8

Once all front panel controls have been set, all the settings can be stored in a memory for later recall. Storage capacity for eight such pre-programmable front panel menus is provided in non-volatile (EAROM) memory. This means these programs are not lost during line voltage interruptions and no batteries are needed for memory back-up.

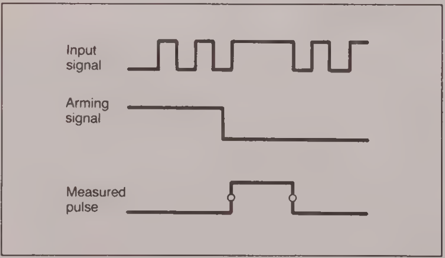
The stored programs memorize even numeric values such as trigger level voltages, measuring time and the mathematical conversion factors K and L. Recalling such programmed front panel menus is as simple as the selection of a measuring function: just pushing one button. All front panel menus can also be stored and recalled via the IEEE-488 bus.


PM 6654C programmable high resolution timer/counter 2ns single shot resolution
10.00000000 6
MATH
HOLD OFF
MEASURING TIME
DISPLAY TIME
SET VIA KEYBOARD

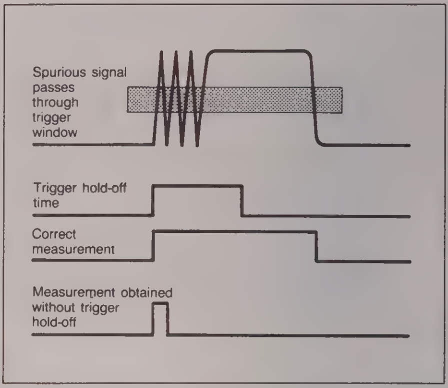
The trigger level READ function displays simultaneously the trigger levels of both the A and B channels, whether being set manually with a vernier or via the keyboard or in the AUTO trigger mode.



The PM 6652C/6654C feature hysteresis compensation. The trigger level is lowered on positive slopes and raised on negative slopes, resulting in a residual hysteresis band which is virtually 10 mV p-p.



The arming input facility prevents the counter from being triggered as long as this input is kept high. Releasing this input arms the counter, which is then ready for triggering, immediately on the first incoming signal.


Spurious signal passes through trigger window
Trigger hold-off time
Correct measurement
Measurement obtained without trigger hold-off

Use of the variable trigger hold-off prevents false stops due to spurious signals such as ringing or relay contact bounce. It also enables time measurements to be made on double pulses, bursts or other complex signals.

Automatic Triggering

The PM 6652C & 6654C have three different trigger level setting modes:

- AUTO selection for foolproof operation and maximum convenience.
- Digital selection via the keyboard for maximum setting accuracy.
- Manual potentiometer setting for increased flexibility.

In the AUTO mode, the counter measures first the maximum and minimum voltages of the input signals. Thereafter, the microcomputer calculates the 50% values to set the trigger levels. When measuring rise or fall times, the 10% and 90% levels are calculated.

Trigger Indicators

Tri-state trigger indicator LEDs on the PM 6652C & 6654C blink to indicate that the inputs are triggered. This feature is of great help when setting the trigger levels manually or via the keyboard.

Variable Measuring Time

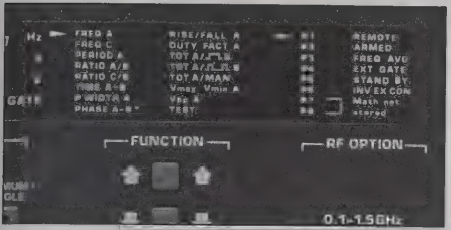
Another microcomputer benefit is the continuously variable measuring time, which is not limited to decade steps. It is possible, for example, to select 2.4 seconds if one second does not give sufficient resolution. This avoids the need to select a time-wasting 10-second measuring period. Pressing the READ button shows instantaneously the measuring time selected.

For a microsecond measuring time or measurements of one-shot phenomena, MINIMUM/SINGLE button is used.

Trigger Level Outputs

Trigger level outputs on the rear panel are available for readout on an oscilloscope. Set trigger levels can then be viewed with respect to the input signals. They can also be used as bus programmable DACs.

PM 6654C & PM 6652C



Detail of front showing up/down moving cursor fo clear indication of selected function.

Choice of Crystal Oscillators

The time base crystal oscillator determines the accuracy limit of the timer/counters. The Crystal oscillator summary shows which of the five stability versions best fits the user's requirements. The choice ranges from an economy standard oscillator to the 5 x 10^{-10}/24h high-stability ovenized oscillator PM 9691 for high accuracy measurements and fewer recalibrations. The high-stability crystal oscillators are also available as retrofittable options for later upgrading of the counter performance. By means of the external reference input, it is possible to utilize the user's own frequency standard, when available.

Powerful IEEE-488 Bus Capabilities

Both the PM 6652C and PM 6654C are fully programmable, including all front-end controls and trigger level voltages. The optional PM 9696 interface board makes the counters IEEE-488/IEC-625 bus-compatible at a small additional cost. Advanced software features are available, including bus learn mode and programmable delimiters. In addition, the high-speed dump mode allows the user to fully exploit the high-resolution / high-measuring speed of the PM 6654C, allowing up to 400 - 500 measurements per second. Pre-set limit monitoring is another useful feature, allowing the counter to SRQ when low or high limits are exceeded.

Powerful, Flexible Software for User Convenience

The PM 6652C & 6654C's bus interface fully complies with IEEE-488/IEC-625-1 hardware standards, as well as with the code and format conventions (software) of IEEE-728/IEC-625-2. To satisfy application needs for both temporary interfaced instrument clusters — and for permanent test systems, the PM 6652C & 6654C feature a flexible and powerful software approach. Three programming modes give ease and simplicity of programming and powerful, high-speed bus operation. Other friendly features include:

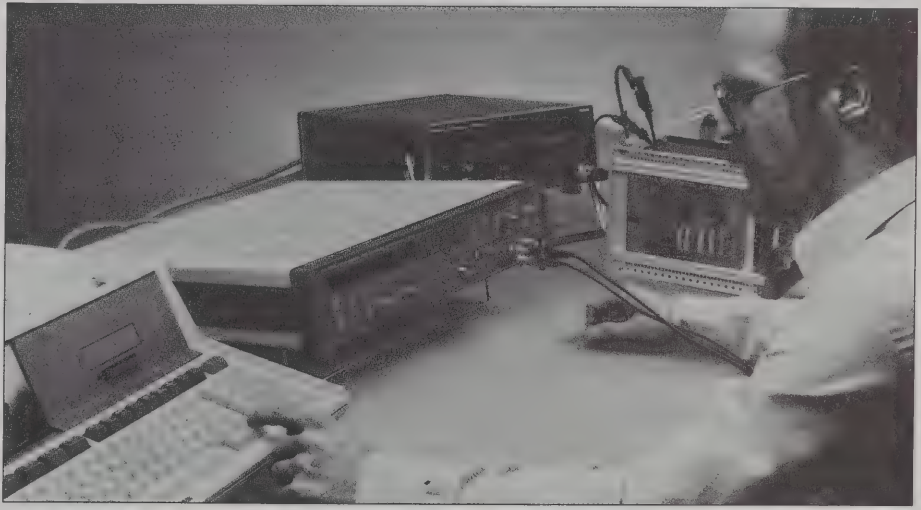
- Acceptance of all available input delimiters as well as output of any delimiter (hardware and/or software selectable) to suit any controller.
- In the 'normal' programming mode, only modifications to the current programming status need to be sent as program messages.
- The mnemonics used are short (maximum three characters) for maximum communication and interpretation speed — but they are easily recognized and can be sent in any sequence. For instance SM 1.5 means: set measuring time to 1.5s.
- Numerical values for trigger levels, measuring times and conversation factors K and L are accepted in all three standardized formats: NR 1, NR 2 and NR 3 (IEEE-728, IEC-625-2, ANSI-X3.42).

Built for ATE Systems

Particular system requirements are met by the inclusion of the following options: The cooling fan, PM 9612 can be built-in for operation in rack-systems, with excessive ambient temperatures. With the PM 9611, the counter is supplied wired with rear panel measuring input connectors instead of the front panel inputs. The counters can also be fitted with rack mount slide PM 9613 for quick and easy accessibility, when mounted in a rack.

Bus Learn Mode

Ease of programming is further enhanced by the bus 'learn' mode, which lets the counter write its own program messages, thereby eliminating programming errors and the need for debugging. In LOCAL mode the counter can be set manually to check whether the measurement is correctly performed. The controller can then ask the counter for the corresponding program string which can be 'copied' by the controller and used for reprogramming the counter.



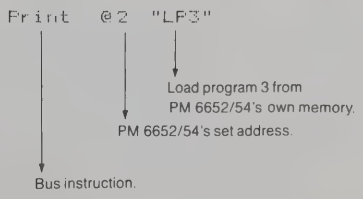
High Speed Data Output

Depending on the measuring function, the PM 6652C & 6654C's high bus speed allows 30-50 measurements per second to be made when used in the normal data output mode. To record very high-speed phenomena, the high- speed dump mode enables some 400-500 measurements per second to be made. In this mode, the raw measuring data from the counting registers are output without being processed by the counter's micro-computer. The algorithms for subsequent processing in the bus controller are given in the manual. A third output data mode is for monitoring processes or for 'go/no-go' testing. It completely eliminates the need for bus communication, as long as the measurement results are within set limits. An SRQ-alarm is given by the counter as soon as a measuring result exceeds the set limits stored in the counter's memory.

System Reliability Testing

Reliable system operation is greatly enhanced by the built-in facility of both hardware

The ultimate in bus operation simplicity
*It is only required to manually set and store all desired timer/counter controls in one of the counter's own memory locations P1...P8, then recall via the bus the manually stored 'menu' with a **single** bus command. Example command from a 1722A Instrument Controller to a PM 6652C/6654C.*



```
Print  @2  "LP3"
```

Load program 3 from PM 6652/54's own memory.
PM 6652/54's set address.
Bus instruction.

PM 6654C & PM 6652C

and software testing. The self-diagnostic TEST 1...5 can be activated via the bus, when the counter is not busy with measurements, ensure dependable hardware performance. System hang-ups caused by, for instance, the absence of an input signal can easily be identified by the comprehensive status byte information. The PM 6652C & PM 6654C feature over 30 different status byte messages.

MATE/CIIL Interface

The counters can be equipped with a MATE/CIIL Interface, for system use in MATE (modulars ATE) environments. Via the high-level CIIL (Control Interface Intermediate Language), all counter functions are fully controlled.

Specifications

Measuring Modes for PM 6652C

Frequency A

Range: 0.1 Hz...120 MHz (0.01 Hz...200 kHz when HOLD-OFF is selected).
Typically 120...160 MHz at 50 mV sensitivity
Mode: Reciprocal below 10 MHz and when HOLD-OFF, EXT GATE or AVERAGE is selected. Conventional above 10 MHz.
LSD Displayed:

$$\frac{2.5 \times 10^{-7}\text{s} \times \text{FREQ}}{\text{measuring time}} \quad \text{(reciprocal)}$$

$$\frac{2.5}{\text{measuring time}} \quad \text{(conventional)}$$

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext. Controls: EXT GATE, AVERAGE, ARMING

Frequency C Optional

Range: 100 MHz...1.5 GHz
Mode: Conventional. (Reciprocal when EXT GATE or AVERAGE is selected).
LSD Displayed:

$$\frac{40}{\text{measuring time}} \quad \text{(conventional)}$$

$$\frac{2.5 \times 10^{-7}\text{s} \times \text{FREQ}}{\text{measuring time}} \quad \text{(reciprocal)}$$

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \text{time base error}$$

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext. Controls: EXT GATE, AVERAGE, ARMING.

Period A

Range: 100 ns...10^{10}s
LSD Displayed:

$$\frac{2.5 \times 10^{-7}\text{s} \times \text{PERIOD}}{\text{measuring time}}$$

Resolution: 1 or 2 LSD units, LSD and resolution is 100 ns when SINGLE PERIOD is selected.
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Number of Cycles Averaged:

$$\frac{\text{measuring time}}{\text{PERIOD}} \quad \text{or a single period}$$

Ext. Controls: EXT GATE, AVERAGE, ARMING

Time Interval A-B, Pulse Width A, Rise/Fall A; Single

Range: 100 ns...10^{10}s
LSD Displayed: 100 ns (TIME <10^3s)

$$\frac{5 \times \text{TIME}}{10^{10}} \quad (\text{TIME} \geq 10^3\text{s})$$

Resolution: 1 LSD unit
Accuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}} \pm \frac{\text{trigger error}}{\text{TIME}}$$

± time base error
Min. Amplitude for RISE/FALL TIME Measurements: 500 mV_{pp}
Ext. Controls: ARMING

Time Interval A-B, Pulse Width A, Rise/Fall A; Averaged

Range:
Time Interval: 0 ns...100s
Pulse Width: 4 ns...100s
Rise/Fall Time: 8 ns...100s
LSD Displayed:

$$\frac{2.5 \times 10^{-8}\text{s}}{\sqrt{N}}$$

Resolution:

$$\frac{100 \text{ ns}}{\sqrt{N}}$$

or 1 LSD unit, whichever is greatest.

Accuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}} \pm \frac{\text{trigger error}}{\sqrt{N} \times \text{TIME}}$$

$$\pm \text{time base error} \pm \frac{\text{syst. error}}{\text{TIME}}$$

Min. Dead Time Stop to Start: 250 ns
Number of Samples Averaged (N):

$$\frac{\text{measuring time}}{\text{pulse repetition time}}$$

Min. Amplitude for RISE/FALL Measurements: 500 mV_{pp}
Ext. Controls: AVERAGE, ARMING.

Measuring Modes for PM 6654C

Frequency A

Range: 0.01 Hz...120 MHz (0.01 Hz...200 kHz when HOLD-OFF is selected).
Typically 120...160 MHz at 50 mV sensitivity
Mode: Reciprocal
LSD Displayed:

$$\frac{5 \times 10^{-9}\text{s} \times \text{FREQ}}{\text{measuring time}}$$

When HOLD-OFF or EXT GATE is selected, see specification for PM 6652C.

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext. Controls: EXT GATE, AVERAGE, ARMING

Frequency C optional

Range: 100 MHz...1.5 GHz
Mode: Reciprocal
LSD Displayed:

$$\frac{5 \times 10^{-9}\text{s} \times \text{FREQ}}{\text{measuring time}}$$

When EXT GATE is selected, see specification for PM 6652C.

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \text{time base error}$$

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext. Controls: EXT GATE, AVERAGE, ARMING

Period A

Range: 8 ns...100s
LSD Displayed:

$$\frac{5 \times 10^{-9}\text{s} \times \text{PERIOD}}{\text{measuring time}}$$

When HOLD-OFF or EXT GATE is selected, see specification for PM 6652C.

Resolution: 1 or 2 LSD units, LSD is 1 ns and resolution 2 ns, when SINGLE PERIOD is selected.

Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{PERIOD}} \pm \frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Number of Cycles Averaged:

$$\frac{\text{measuring time}}{\text{PERIOD}} \text{ or a single period}$$

Ext.Controls: EXT GATE, AVERAGE, ARMING

Time Interval A-B, Pulse Width A, Rise/Fall A; Single

Range: 8 ns...10^{10}s
LSD Displayed: 1 ns (TIME <10s)

$$\frac{5 \times \text{TIME}}{10^{10}} \text{ (TIME} \geq 10\text{s)}$$

Resolution: 2 ns (TIME <10s); 1 LSD unit (TIME ≥10s)
Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}} \pm \frac{\text{trigger error}}{\text{TIME}}$$

$$\pm \text{ time base error} \pm \frac{\text{syst. error}}{\text{TIME}}$$

Min. Amplitude for RISE/FALL TIME Measurements: 500 mV_{pp}
Ext. Controls: ARMING
Note: When HOLD-OFF is selected, see specifications for PM 6652C.

Time Interval A-B, Pulse Width A, Rise/Fall A; Averaged

Range:
Time Interval: 0 ns...100s
Pulse Width: 4 ns...100s
Rise/Fall Time: 8 ns...100s
LSD Displayed:

$$\frac{2.5 \times 10^{-9}\text{s}}{\sqrt{N}}$$

Resolution:

$$\frac{10 \text{ ns}}{\sqrt{N}}$$

or 1 LSD unit, whichever is greatest.

Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}} \pm \frac{\text{trigger error}}{\sqrt{N} \times \text{TIME}}$$

$$\pm \text{ time base error} \pm \frac{\text{syst. error}}{\text{TIME}}$$

Min. Dead Time Stop to Start: 50 ns
Number of Samples Averaged (N):

$$\frac{\text{measuring time}}{\text{pulse repetition time}}$$

Min. Amplitude for RISE/FALL Measurements: 500 mVpp
Ext. Controls: AVERAGE, ARMING.
Note: When HOLD-OFF is selected, see specification for PM 6652C.

Measuring Modes Common for PM 6652C and PM 6654C

Duty Factor A

Range: 0...1 - (250 ns x Pulse rep. rate)
Example: 0...0.9999 at 50 Hz; 0...0.9997 at 1 kHz; 0...0.5 at 2 MHz
Frequency Range: 0.03 Hz...2 MHz
LSD Displayed:

$$\frac{2.5 \times 10^{-7}\text{s}}{\text{measuring time}}$$

Resolution: 100 ns x pulse rep. rate/√N or 1 LSD unit, whichever is greatest
Accuracy:

$$\pm\frac{4 \text{ ns} \times \text{FREQ}}{\text{DUTY FACTOR}} \pm \frac{\text{resolution}}{\text{DUTY FACTOR}}$$

$$\pm\frac{\text{trigger error}}{\sqrt{N} \times \text{PULSEWIDTH}}$$

Number of Cycles Averaged (N): Measuring time x pulse rep. rate
Ext.Controls: None

Totalize A

Range: 1...10^{18}
Frequency Range: 0...120 MHz and 0.01 Hz...200 kHz when HOLD-OFF is selected
Pulse Pair Resolution: 8 ns
Manual Mode: Controlled by pushbutton START/STOP
External Mode: Totalizing on A during pulse duration on B or between start/stop pulses on B.
Accuracy:

$$\pm\frac{\text{Pulse rate A} \times \text{trigger error B}}{\text{total counts}}$$

Ext. Controls: ARMING (not valid in manual mode).

Ratio A/B

Range: 10^{-9}...10^{10}
Frequency Range:
0.1 Hz...120 MHz/0.01 Hz...10 MHz (0.01 Hz...200 kHz/0.01 Hz...10 MHz when HOLD-OFF is selected).
LSD Displayed:

$$\frac{2.5 \times \text{RATIO}}{\text{measuring time} \times \text{FREQ A}}$$

Resolution: 1 or 2 LSD units
Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{RATIO}} \pm \frac{\text{trigger error B}}{\text{measuring time}}$$

Ext. Controls: ARMING

Ratio C/B

Range: 10^{1}...10^{11}
Frequency Range:
100 MHz...1.5 GHz/0.01 Hz...10 MHz.
LSD Displayed:

$$\frac{40 \times \text{RATIO}}{\text{measuring time} \times \text{FREQ C}}$$

Resolution: 1 or 2 LSD units
Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{RATIO}} \pm \frac{\text{trigger error B}}{\text{measuring time}}$$

Ext. Controls: ARMING

Phase A-B

Range: 0...360° x (1 - 250 ns x FREQ)
Example: 0...360° at 50 Hz; 0...359.9° at 1 kHz; 0...180° at 2 MHz
Frequency Range: 0.03 Hz...2 MHz
LSD Displayed:
1° Measuring time ≤180µs;
0.1° Measuring time 180 µs...1.8 ms;
0.01° Measuring time ≥1.8 ms
Resolution: 1 LSD unit
Inaccuracy:

$$\pm\frac{4 \text{ ns} \times 360^\circ \times \text{FREQ}}{\text{PHASE}} \pm \frac{\text{resolution}}{\text{PHASE}}$$

$$\pm\frac{\text{FREQ} \times 360^\circ \times \text{trigger error}}{\sqrt{N} \times \text{PHASE}}$$

$$\pm\frac{\text{systematic error}}{\text{PHASE}}$$

Input Voltage: 100 mV...3.5V or 1V...35V (RMS sine).
Number of Cycles Averaged (N): Measuring time x FREQ A
Ext. Controls: None

V_{max}, V_{min}, V_{pp} A

Range: -50V...+50V; DC and 100 Hz...120 MHz
LSD Displayed:
10 mV for signals within ±5V
100 mV for signals outside ±5V
Resolution: 1 LSD-unit

Typical Inaccuracy (mV):
DC and 100 Hz...20 MHz
Input Signals Within ±5V:
±(20 mV + 2% of reading)
Input Signals Outside ±5V:
±(200 mV + 3% of reading)

Typical Inaccuracy (mV):
20 MHz...80 MHz (50 Ohm):
Input Signals Within ±5V:
±(20 mV + 6% of reading)
Input Signals Outside ±5V:
±(200 mV + 7% of reading)

High-Freq. Error: >80 MHz (50Ω) or >20 MHz (1 MΩ) deviation is typically ±3 dB
Ext. Controls: None

PM 6654C & PM 6652C

Definitions

Synchronization Modes:

Conventional Mode means that the gate time is synchronized with an integer number of clock pulses. The error is ±1 input cycle. (Only used in the PM 6652C above 10 MHz).
Reciprocal Mode means that the gate time is synchronized with an integer number of input cycles. The error is ±1 clock pulse, i.e. ±100 ns (PM 6652C) or ±2 ns (PM 6654C). The use of this mode gives 7 digits (PM 6652C) or 9 digits (PM 6654C) resolution for a one second measuring time.

LSD Displayed:

Unit value of the Least Significant Digit displayed. All calculated LSDs (see section Measuring modes) should be rounded to the nearest decade before display (e.g. 5 ns will be 10 ns and 0.4 Hz will be 0.1 Hz) and cannot exceed the 10th digit.

Accuracy:

The accuracy (relative error) of a measurement is dependent on 4 factors:

- rel. resolution
- rel. time base error (if any)
- rel. trigger error (if any)
- rel. systematic error (if any)

Accuracy + ± rel. resolution ± rel. time base error ± rel. trigger error ± rel. systematic error

Resolution

For Multiple Event Measurements: FREQUENCY, PERIOD and RATIO,the resolution is the smallest increment between two measuring results. The measuring resolution is due to the ±1 count error. After calculation, the result to be displayed is truncated to include only significant digits, giving a measuring resolution of 0.2...2 LSD units. Total resolution, including LSD resolution is therefore 1 LSD unit (70% probability) or 2 LSD units (30% probability) but can always be reduced to 1 LSD unit by increasing the measuring time somewhat.
For Single Event Measurements: PERIOD SINGLE and TIME INTERVAL SINGLE, resolution is one clock pulse period, regardless of the measuring time.
For Statistical Measurements: TIME INTERVAL AVERAGE, RISE/FALL TIME, PULSE WIDTH, PHASE and DUTY FACTOR,the resolution is the smallest increment between two measuring results with a confidence level of 95%.

Time Base Error:

The relative time base error is the relative deviation of the clock pulse frequency from 10 MHz. Rel. time base error = Δf/10 MHz. See spec. for oscillators.

Trigger Error:

Trigger error (T.E.) is the absolute measurement error due to input noise causing triggering which is too early or too late.
Frequency, Period, Ratio: T.E. = ± Noise Voltage (V_{pp})/Signal slew rate (V/s);
T.E. = ± 1/FREQ x π x S/N-ratio (sinewave)
Time Interval, Rise/Fall Time, Pulse Width, Duty Factor: T.E. = ± Noise Voltage (V_p)/slew rate at START point ± Noise Voltage (V_p)/slew rate at STOP point
Phase: T.E. = ± 1/(FREQ x π x S/N-ratio) (sinewave, same S/N-ratio for both channels).

Systematic Errors:

When a systematic error is known, the measured value can be compensated by using the MATH function.
Time Interval, Pulse Width: Syst. error < ±2 ns (PM 6654C) or < ±4 ns (PM 6652C)
Rise/Fall Time: Syst. error = TIME INTERVAL Syst. error ±

$$\pm\frac{2\%\text{ of }V_{pp}\text{ (A)} + 5\text{ mV}}{\text{slew rate (A) at 10\% (V/s)}}$$

$$\pm\frac{2\%\text{ of }V_{pp}\text{ (A)} + 5\text{ mV}}{\text{slew rate (A) at 90\% (V/s)}}$$

Phase (AC-Coupling, Trigger Level = 0V)
Sinewave:
Syst. error
<arcsin (5 mV/U_{max}A) - arcsin (5 mV/U_{max}B)
Triangular wave:

$$\text{Syst.error} < \frac{5\text{ mV} \times 90°}{U_{max}A} - \frac{5\text{ mV} \times 90°}{U_{max}B}$$

Input Specification

Inputs A and B

Frequency Range: *DC-coupled:* 0...120 MHz; *AC-coupled:* 20 Hz...120 MHz
Rise Time: Approx 1 ns
Sensitivity: 20 mV_{RMS} sinewave or 60 mV_{p-p} (0...60 MHz); 30 mV_{RMS} sinewave or 90 mV_{p-p} (60...120 MHz)
Min. Pulse Duration: 4 ns
Attenuation: x 1, x 10 (fixed)
Hysteresis Band: Approx. 40 mV_{p-p}
Hysteresis compensation is automatically performed in TIME A-B, P Width A, RISE/FALL A, PHASE A-B and DUTY FACTOR measuring modes; resulting in a residual hysteresis band which is virtually 10 mV_{p-p}.
Dynamic Input Voltage Range:
60 mV_{p-p} within ±5V_{p-p} ±5V_{DC} (x 1);
600 mV_{p-p} within ±50V_{p-p} ±50V_{DC} (x 10)
Trigger Level Selection: Manually via keyboard (10 mV steps); Manually via potentiometers; Auto trigger
Trigger Level Range: -5V...+5v (x 1); -50V...+50V (x 10)
Trigger Slopes: Positive or negative
Trigger Level Output: Set trigger levels for channel A and B, -5V...+5V, available at rear panel (BNC-connectors).
Trigger Level Readout: Set trigger levels for channel A and B are displayed with a resolution of 10 mV (x 1) or 100 mV (x 10)
Trigger Indicators: Tri-state LED indication
On: Signal is above the set trigger level
Blinking: Triggering occurs
Off: Signal is below the set trigger level
AUTO Trigger: The AUTO trigger will automatically set A and B trigger levels to 50% of input signal amplitude (10% and 90% for rise/fall time measurements).
Frequency range: 100 Hz...120 MHz
Measuring cycle time: Approx. 300 ms + measuring time.
Note: Auto trigger requires a repetitive signal. Input signal may have any duty factor.
Coupling: DC/AC
Channel Input: Separate A and B or common via A
Impedance: Separate A and B: 1 MΩ//35 pF or 50Ω nominal (A and B);
Common A: 0.5 MΩ//70 pF nominal or 50Ω nominal (A). Open input (B).
Max. Voltage Without Damage:
1 MΩ (x 1): 260V_{RMS} ≤20 kHz, declining to 12 V_{RMS} at ≥1 MHz
1 MΩ (x 10): 260V_{RMS} ≤20 kHz, declining to 100V_{RMS} at 1 MHz and to 25V_{RMS} at 120 MHz
50Ω: 12V_{RMS} DC...120 MHz

Input C (Option/PM 9610)

Frequency: 100 MHz...1.5 GHz
Operating Input Voltage Range:
10 mV_{RMS}...12 mV_{RMS} (100 MHz...1 GHz)
30 mV_{RMS}...12 mV_{RMS} (1...1.5 GHz)
Coupling: AC
Impedance: 50Ω nominal; VSWR ≤2
AM Tolerance: 98%; minimum signal must exceed minimum operating input voltage
Max. Voltage Without Damage: 12V_{RMS}; overload protection with PIN diodes

Input D (Ext. standard in)

Range: 100 kHz...10 MHz
Coupling: AC
Impedance: 1.5 kΩ nominal
Sensitivity: 400 mVRMS
Max. Voltage Without Damage: 25V_{RMS}
Note: As external reference frequency, only 10 MHz will give correct decimal point and unit indication. With the optional frequency multiplier PM 9697 references of 1 and 5 MHz can also be accepted.

Input E (Ext. reset)

Electrical reset, equivalent to front panel RESET pushbutton. Counter is reset when input E is high. A new measurement can be made after input E has returned low. The measurement will start after a delay of approx. 50 ms to 100 ms (depending on selected function) plus time needed for synchronization with the input signal.
Active High Level: ≥2V
Passive Low Level: ≤0.5V
Impedance: 2 kΩnominal
Max. Voltage Without Damage: ±25V
Min. Pulse Duration: 50 ns

Input F (Arming, Ext. gate, Average)

A 4-position rear panel switch gives choice of external control of the counter
OFF: No function selected
ARMING: The counter is prevented from starting a new measurement when input F is high. A high-to-low transition arms the counter to start a new measurement. Arming is not applicable in TOT A (manual), PHASE and DUTY FACTOR measurements.
AVERAGE: Frequency (channel A or C), period A and time interval A-B measurements are interrupted when input F is high. The measurement is continued again when input F is low.
EXT. GATE: The signal on input F defines start and stop of the measuring time and overrides the set MEASURING TIME. The measurement will start when input F goes high, after a synchronization delay. The measurement will stop when input F returns low, after a synchronization delay.
High Level: ≥2V
Low Level: ≤0.5V
Impedance: 2 kΩ nominal
Max. Voltage Without Damage: ±25V
Min. Pulse Duration (Arming): 200 ns
Min. Pulse Duration(Ext. gate): 500 ns
Min. Pulse Duration (Average):
PM 6652C: 500 ns; *PM 6654C:* 200 ns
Internal Delay: Approx. 50 ns

Output Specifications

Output G (10 MHz out)

Output Frequency: 10 MHz
Output Level: 1.3V_{p-p} in 50Ω load
Output Protection: Short-circuit proof

Output H (Gate Open)

The gate status output allows monitoring on an oscilloscope of the actual measuring time and the trigger hold-off time.
Output Levels:
Main gate closed: Approx.4.5V;
Main gate open: Approx. 0V;
Hold-off time: Approx. 1.2V
Output Impedance: Approx. 1.5 kΩ
Internal Delay: Approx. 150 ns
Output Protection: Short-circuit proof

Outputs I and J (Trigg Level Out)

Buffered output for set trigger levels on channels A and B. The range is -5V...+5V unaffected by the input attenuator setting (x 1 or x 10). The outputs can be used as two independent bus programmable DACs.
Output Levels: -5V...+5V
Output Impedance: Approx. 2 kΩ
Output Protection: Short-circuit proof
Non-Linearity Error: Less than ±5 mV
DC-Offset: Less than ±7 mV
Setting Time: Less than 1 ms

Auxiliary Functions

Measuring Time/Display Time

The measuring time can be selected in three different ways:
Variable: The measuring time is continuously variable 0.1 ms...96s, with clear setpoints at 0.1 ms, 1 ms, 10 ms, 0.1s, 1s, 10s and 96s. Selected variable measuring time is displayed, without any delay, when depressing the measuring time "READ" push-button.
Minimum/Single: With minimum/single activated the counter will perform single event measurements for: PERIOD A, RATIO A/B, RATIO C/B, TIME A-B, P WIDTH A, and RISE/ FALL A.
A minimum measuring time of approx. 2µs is performed for FREQ A, FREQ C in PM 6654C.
A minimum measuring time of approx. 1µs is performed for FREQ A, FREQ C in PM 6652C and for PHASE A-B and DUTY FACTOR A in both PM 6652C and PM 6654C.
The variable MEASURING TIME/DISPLAY TIME control will now act only as display time control. The measured result is displayed during the set display time and a new measurement will start at the next input signal.
Ext. Gate: The use of EXT GATE (see INPUT specifications) will override the set measuring time. The external gate duration must be in the range 500µs...96s.

Display Hold:

Depressing the DISP HOLD push-button sets display time to infinity and freezes the last measurement result. A new measurement can be initiated using RESET.

Hold-Off:

With trigger HOLD-OFF activated the counter ignores re-triggering (channel A) or stop-triggering (channel B) during the set hold-off time. The hold-off function is applicable in all channel A measuring modes and also on channel B in the TIME A-B mode. The hold-off function can be used as low-pass filter with variable cut-off frequency between 5 Hz...150 kHz for FREQUENCY and PERIOD measurements.
Range: 5µs...200 ms or 0 (OFF)
Read-Out: The hold-off time is measured and displayed by pressing the READ push-button.
Monitor: The set hold-off duration is visible via the GATE OPEN output.

Note: When hold-off is active, the frequency measurements are limited to 0.01 Hz...200 kHz (PM 6652C and PM 6654C) and clock resolution in all measuring modes will always be 100 ns (PM 6654C).

Time Interval Delay (T.I. delay):

The T.I. delay is a bus-programmable Hold-off, active in PM 6654C in the modes:
- Time Interval A-B, single
- Pulse width A, single
- Rise/Fall Time A, single

Range: 100 µs...99s
Accuracy: 25 µs ±1% of set value

Mathematics:

The mathematical functions of PM 6652C and PM 6654C make it possible to offset a measuring value or to change scale factor (normalizing). The offset facility allows adding or subtracting a reference value to the measured value before display, e.g. measurement of tuned receiver frequency, by measuring the local oscillator frequency (IF-offset).
The scaling facility allows multiplying of the measured value by a constant before display, e.g. conversation of frequency to RPM.
The scaling and offset features may be combined, so that the displayed value equals K*X+L. X is the measured value and K and L are constants.

Check:

10 MHz internal reference is connected to the counting logic of input channels A and B. Self-test of most measuring functions can be selected.

Reset:

Manual via push-button or electrical via input E. Reset will clear keyboard entry status, clear an active STORE state, and/or start a new measurement.

Power On/Stand By:

In "ST BY" position, power is available to maintain an ovenized crystal oscillator.

Test Function:

The counter performs a choice of 5 self test routines of the logic and computing functions. The functions tested are: ROM (No. 1), RAM (No. 2), EAROM (No. 3), measuring logic (No. 4) and display (No. 5), Test No. 6 when selected will perform all tests 1...5 in a sequence.
At power-up a limited test sequence is performed.

Programs P1...P8:

Eight front panel "menus" can be stored in and recalled from a non-volatile memory. All front and rear panel settings can be stored; except hold-off value (but status of push-button "HOLD-OFF on/off" is stored). Programs P7 and P8 can not store the mathematical functions.

Time Base:

For specifications see chart on following page.

General Specifications

Display

Read Out: 10 digits, sign and exponent (engineering notation) 11 mm high-efficiency LED.
Unit Indicators: 3 LEDs indicating Hz, s or V. Any prefix (kHz, µs) is indicated by the exponent on the display.
Gate Lamp: Indicates that main-gate is opened and measurement takes place.

PM 6654C & PM 6652C

St By: Stand-by indication with LED when instrument is not switched ON.
Remote: Indicates that the counter is remotely controlled via the BUS interface option (IEC-625, IEEE-488).
Armed/Freq Avg/Ext Gate: Indicates position of rear panel EXT CONTROL switch (LOCAL mode) or programmed setting of EXT CONTROL function (REMOTE mode).
Cursor: Indicates selected measuring function and/or selected front panel menu (Programs P1...P8).

Power Requirements:

In addition to the normal line voltage supply, the PM 6652C and PM 6654C can also be powered by an external DC voltage; 17V...29V.
Line: 115/230V ±15%; 45...440Hz 60 VA
Line Interference: Below VDE 0871 (B) and MIL STD 461
Safety: According to IEC 348 and CSA 556 B

Dimensions and Weight:

440 mm W x 89 mm H x 440 mm L (excl. 19" brackets) (17.3 in W x 3.5 in H x 17.3 in L)
Net: Approx. 8 kg (17.5 lb)
Shipping: Approx. 10 kg (22 lb)

Environmental Conditions

Ambient Temperature:
Storage and transport: -40°C...+70°C;
Rated range of use: -5°C....50°C
To allow air convection, at least 2 cm free space is required above and below the counter. Without any free air space around the counter (tightly packed 19 inch racks), the built-in fan option PM 9612 is necessary at ambient temperatures above 40°C.
Humidity:
Operating: 10...90% RH, no condensation;
Storage: 5...95% RH
Altitude/Barometric Pressure:
Operating: 5 000m (15 00 ft) -53.3 kN/m²
Storage: 15 000m (50 000 ft) -15.2 kN/m²

GPIB/IEEE-488 Bus Data

(PM 9696 Installed)

The PM 6652C and PM 6654C timer/counters are IEEE-488 bus programmable through the optional hardware interface PM 9696B.

Programming Instructions:

Programming modes: The counter can be programmed in 3 different ways:
Remote recall of P1...P8: Manually stored front panel menus are recalled with one single bus-command (LP1...LP8).
Bus learn mode: The programming codes for all manually set controls are sent from the counter and stored in the controller's memory with one single bus-command. The string of codes can later be returned to the counter for reprogramming.
Normal mode: Only changes in the current programming status need to be programmed, and can be sent in an arbitrary order. Any number of spaces can be inserted anywhere in the programming string. The counter complies with IEC-625-2 and IEEE-728 and accepts all standardized formats for numeric values; NR1, NR2 and NR3.

Output Messages:

High Speed Dump Mode: The contents of the counting registers are sent to the controller without being processed by the internal microcomputer. The processing must be done in the controller instead.
Limit Monitoring: The MATH constants K and L will specify upper and lower limits for the measurement. When the input signal exceeds either of the limits, an SRQ-alarm is sent to the controller. Limit monitoring is not applicable in the V_{max} V_{min} measuring mode.

Timing Characteristics:

Max. Data Output Rate:
Normal mode: 30-50 readings/sec.;
High speed dump mode: Approx. 420 readings/sec.
V_{max}, V_{min} *or* V_{p-p}: 3-4 readings/sec.

Optional Accessories

Analog Recorder Output PM 9695

The digital-to-analog converter PM 9695 provides a high resolution analog output e.g. for recording frequency stabilities of oscillators, filters and crystals on a strip chart recorder. In frequency control systems having analog feedback, the DAC serves as an extremely accurate frequency-voltage converter. The PM 9695 permits conversion of any three consecutive digits; as such it functions as a magnifying glass to focus on the most important part of the readout.
Decade Conversion: Any 3 consecutive digits can be selected. The value of the least significant of the 3 digits can be selected with a 12-position switch.
Normal Mode: Analog output is directly proportional to digital input. 000 produces 0.000V. 999 produces 0.999V.
Output:
Zero output: 0V;
Full scale deflection: 0.999V
Connector: BNC

Ext. Reference Frequency Multiplier PM 9697:

To accept external reference frequencies other than 10 MHz, the frequency multiplier PM 9697 can be ordered.
With this option installed, the PM 6652C or PM 6654C can accept external reference frequencies of 1 MHz, 5 MHz or 10 MHz. All other input specifications as for "Input D".
Included With Instrument: Operating manual, power cord, rackmounting brackets

Ordering Information

Models

January 1989 prices

PM 6652C 120 MHz, 100 ns Timer/Counter	$2280
PM 6654C Plus 2 ns resolution	2500

Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit /suffix by selecting 1 digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.

Input Frequency Option:

/0-- Standard 120 MHz	N/C
/5-- 1.5 GHz (PM 9610/01)	add 695

Reference Oscillator Option:

/-1- Standard Crystal	N/C
/-2- TCXO (PM 9678B/01)	add 225
/-3- Ovenized Crystal (PM 9679E/01)	add 450
/-4- Very High Stability Ovenized Crystal (PM 9690/01)	add 645
/-5- Ultra High Stability Ovenized Crystal (PM 9691/01)	add 845
/-8- Standard Crystal plus Externally Referenced Frequency Multiplier (PM 9697/00)	add 175

Interface Option:

/--1 Standard Front Panel Control	N/C
/--2 Blind Panel Version with GPIB IEEE-488 I/F (PM 9696B/00)	consult factory
/--5 Standard Front Panel with Analog Recorder Output (PM 9695/00)	add 405
/--6 Standard Front Panel with GPIB IEEE-488 I/F (PM 9696B/00)	add 300
/--7 Standard Front Panel with GPIB IEEE-488 and MATE/CIIL Interfaces	add C/F

Example, Ordering Configuration
To order the 120 MHz, 100 ns resolution version with TCXO oscillator and standard front panel with GPIB IEEE-488 I/F, select:

		Model	Price
Configuration		PM 6652C	$2280
Option Suffix -	Input	/0--	N/C
	Oscillator	/-2-	225
	Interface	/--6	300
Yields Complete Model Number		PM 6652C/026	2805

PM 6654C & PM 6652C

Options and Accessories

PM 9610/01 1.5 GHz Option (input C)	$695
PM 9611/01 Built-in Rear Panel Input Wiring Option	90
PM 9612/01 Fan	229
PM 9613/01 Rack-Mount Slide Kit	175
PM 9678B/01 TCXO Time Base Oscillator (version/.2.)	225
PM 9679E/01 Ovenized Time Base Oscillator (version/.3.)	450
PM 9690/01 Ovenized Time Base Oscillator (version/.4.)	645
PM 9691/01 Ovenized Time Base Oscillator (version/.5.)	845
PM 9695/00 Analog Recorder Output	405
PM 9696B/00 IEEE-488 Bus Interface	300
PM 9697/00 External Reference Frequency Multiplier	175
PM 9585/01 50Ω Feed-Through Termination; 1W	30
PM 9665B/01 50 kHz Low Pass Filter	35
PM 9666/01 Trigger Level Output Cable	75

The time base oscillators PM 9678 to PM 9691 can also be ordered separately for later upgrading of the counters.
The PM 9611 option is not customer retrofittable, but must be ordered factory installed. The PM 9697 multiplier can be installed only in the /-1-versions.
Older versions of bus interface, PM 9696 (without "RTL-update"), cannot be used in a PM 6652C or PM 6654C.

Service & Support

Warranty

One-year product warranty. See Page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

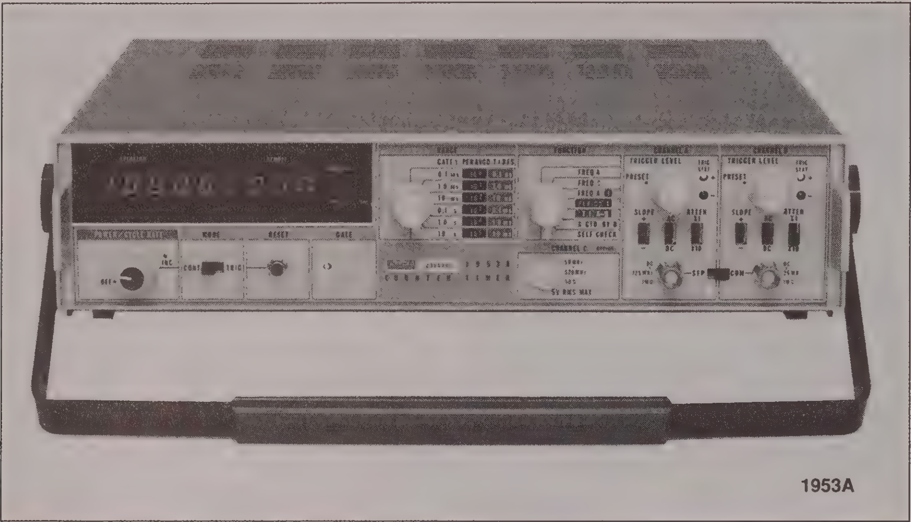
Crystal Oscillator Summary

PM 66../...Version Including Time Base Option	/.1. Standard Version	/.2. Version PM 9678	/.3. Version PM 9679	/.4. Version PM 9690	/.5.Version PM 9691
Stability Against	Standard	TCXO	Oven	Oven	Oven
Aging:/24h /Month /Year	N/A $<5 \times 10^{-7}$ $<5 \times 1^{-6}$	N/A $<1 \times 10^{-7}$ $<5 \times 10^{-7}$	N/A $<1 \times 10^{-7}$ $<5 \times 10^{-7}$	$<1.5 \times 10^{-9*}$ $<3 \times 10^{-8}$ <1.5 x 10-7	$<5 \times 10^{-10*}$ $<1 \times 10^{-8}$ $<7.5 \times 10^{-8}$
Temperature: 0°C to 50°C Ref. to +23°C	$<1 \times 10^{-5}$	$<1 \times 10^{-6}$	$<1 \times 10^{-7}$	$<3 \times 10^{-8}$	$<5 \times 10^{-9}$
Change in supply Mode: line/int. battery /ext. DC 12V to 28V	$<3 \times 10^{-7}$	$<5 \times 10^{-8}$	$<1 \times 10^{-8}$	$<3 \times 10^{-9}$	$<3 \times 10^{-9}$
Line Voltage:±10%	$<1 \times 10^{-8}$	$<1 \times 10^{-9}$	$<1 \times 10^{-9}$	$<5 \times 10^{-10}$	$<5 \times 10^{-10}$
Warm-up time to reach 10^{-7} of final value	N/A	N/A	<10 min	<15 min	<15 min

**After 48 Hours of continuous operation.*

1953A

GPIB
IEEE-488



1953A

1953A Universal Counter/Timer

- Frequency to 125 MHz (optional 520, 1000, 1250 MHz)
- Time interval measurements to 100 ns (single shot); 0.1 μs (averaged)
- Gated totalizing, frequency ratio and period measurements
- Fully GPIB/IEEE-488 programmable, including trigger levels
- 9 digit display

The 1953A is a systems counter with a wide array of options allowing you to select just the capability you need.

The 1953A can provide a variety of measurements: frequency, frequency ratio, period, period averaging, time interval, and gated totalizing. Trigger level controls allow selection of a preset level (0V dc), or adjustment to suit conditions. DMM output jacks and LED status indicators help the user to set the trigger levels properly.

Signal conditioning switches permit the operator to select positive or negative slope trigger, ac or dc coupling, and X1 or X10 attenuation. A marker output is provided for use with an oscilloscope for accurate determination of trigger points.

The GPIB/IEEE-488* interface option allows full programming of function, range, and signal conditioning, including trigger levels. Data output includes 9 digits of display information, decimal point, and exponent. Front panel lockout is provided. TTL level parallel remote programming and digital output options are also available.

Specifications

Technical Specifications

Frequency Measurements

Range: 0 to 125 MHz (dc coupled); 5 Hz to 125 MHz (ac coupled)
Gate Time: 0.1 ms to 10s in 6 decade steps
Resolution: 1/gate time (in Hz)

Period Measurements

Range: 0 to 25 MHz (dc coupled); 5 Hz to 25 MHz (ac coupled)
Periods Averaged: 1 period to 10^5 in decade steps
Resolution: 10^{-7}/periods

Time Interval Measurements

Range: 0.1 μs to 10^7s
Input: Channels A and B, common or separate
Resolution: 10 ms to 0.1 μs in 6 decade steps

Totalize Measurements

Range: 0 to 125 MHz (dc coupled); 5 Hz to 125 MHz (ac coupled)

Ratio Measurements

Display: Ch A/Ch B
Range:
Ch A: 0 to 125 MHz (dc coupled); 5 Hz to 125 MHz (ac coupled)
Ch B: 0 to 25 MHz (dc coupled); 5 Hz to 25 MHz (ac coupled)

Sensitivity

Channel A: 30 mV rms sinewave to 75 MHz, increasing to 50 mV at 125 MHz; 100 mV pulse amplitude with minimum pulse width of 10 ns
Channel B: 30 mV rms sinewave to 25 MHz; 100 mV with minimum pulse width of 50 ns
Channel C:
520 MHz Channel C Input (-07)
Covers frequency range of 50 to 520 MHz, using a scaling ratio of 4. Sensitivity is 15 mV rms (AGC). Maximum allowable input is 5V rms (fuse protected). VSWR less than 2:1 into 508 for levels less than 1V rms
1000 MHz Channel C Input (-13)
Covers 50 to 1000 MHz using a scaling ratio of 8. Sensitivity is 15 mV rms, and maximum al lowable input is 5V rms (fuse protected). VSWR is less than 2.5:1 for levels less than 1V rms
1250 MHz Channel C Input (-14)
Covers 50 to 1250 MHz using a scaling ratio of 8. Sensitivity is 15 mV to 1000 MHz, decreasing to 30 mV rms at 1250 MHz. Maximum input is 5V rms (fuse protected). VSWR is less than 2.5:1 (508) for levels less than 1V rms

Input Impedance

Channel A or B: 1 MΩ ≤30 pF
Channel C: 50Ω nominal

Rear Panel Signals

External Timebase: 10 MHz, 250 mV to 8V
Gate Time: High True, TTL level output
Time Interval Marker: Low True, TTL level output
Trigger Level Output: Channels A & B only

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

Timebases

	Standard	-04 Option	-10 Option	-20 Option
Frequency	10.00 MHz	10.00 MHz	10.00 MHz	10.00 MHz
Aging Rate (Constant Temp)	±3 x 10^{-7}/mo 1 ppm/yr	±3 x 10^{-7}/mo 1 ppm/yr	±1 x 10^{-7}/mo	±1.5 x 10^{-8}/mo
Temp Accuracy 0°C-50°C	±2 x 10^{-6}	±5 x 10^{-7}	±1 x 10^{-8}	<7 x 10^{-9}†
Line Voltage (±10%)	±2 x 10^{-8}	±2 x 10^{-8}	±3 x 10^{-9}	±1 x 10^{-9}

†Peak-to-peak variation

General Specifications

Temperature: 0°C to 50°C, operating; -40°C to +75°C, non-operating
Power: 115 or 230V ac ±10% (100V available), 50 to 400 Hz, 30W nominal
Size: 8.8 cm H x 36.2 W x 34.3 cm D (3.45 in H x 14.25 in W x 13.5 in D)
Weight: 4.32 kg (9.5 lb)

Ordering Information

Models

January 1989 prices

1953A Universal Counter/Timer	$1995
1953A-12 w/ Option -12 Installed	2555
1953A-15* w/Option -15 Installed	2550

**Not compatible with Option -02 or -11*

Options

-02 Digital Output Unit	$300
-04**Superior TCXO	285
-05 Timebase Multiplier	125
-07* 520 MHz	575
-10** Oven-Stabilized Timebase	475
-11** Basic Remote Programming	400
-13* 1000 MHz	725
-14* 1250 MHz	925
-16** Rear Inputs (Channels A,B,C)	95
-20** Superior Oven-Stabilized Timebase	950

* *Factory or Service Center installation only. Options -04, -10, and -20 are mutually exclusive in one mainframe.*

** *Factory installation only*

Accessories (Also see page 485)

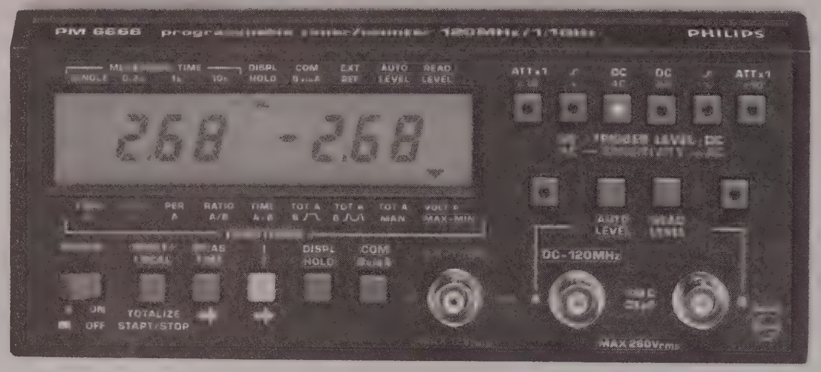
A53 Whip Antenna	$30
Y7201 Attenuator/Filter	65
M00-200-622 3" Rack Adapter	65
M00-200-626 3" Rack Adapter w/slides, for DEC cabinets	135
Y7206 3" Adapter w/slides, for non-DEC cabinets	120
Y8021 1m Cable, IEEE-488 bus	130
Y8022 2m Cable, IEEE-488 bus	145
Y8023 4m Cable, IEEE-488 bus	155
Y9103 50Ω BNC Feed-thru Terminator	35
Y9111 3 ft (0.93m) Coaxial Cable 50Ω, BNC to BNC	20
Y9112 6 ft (1.85m) Coaxial Cable 50Ω, BNC to BNC	20

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

PM 6665 & PM 6666



PM 6666

PM 6665/PM 6666 Programmable Timer/Counters
Unrivalled price/performance
High resolution reciprocal counting
High trigger accuracy
PM 6666: Full GPIB/IEEE-488 programmability, Auto Trigger, Voltage Measurements
PM 6665: Continuously variable sensitivity, HF filter
High stability MTCXO: 2 x 10^{-7} over 0...50°C - push button calibration
9 measuring modes including high resolution time-interval average
1.3 GHz RF-Input

Introduction

The PM 6665 and PM 6666 are very versatile timer/counters with many functions included as standard, spanning frequencies from 0.1 Hz to 120 MHz, and optionally up to 1.3 GHz. The measuring functions include FREQUENCY, PERIOD, FREQ RATIO, TOTALIZE pulses, TIME INTERVAL, RPM (PM 6665) and VOLT peak values (PM 6666).

The units have a built-in microprocessor that uses the reciprocal frequency counting technique, which yields high resolution measuring results under all conditions, even on low frequency measurements.

Measuring accuracy is increased by the high performance counter front-ends, providing variable sensitivity and noise immunity. Accuracy can be further improved with the optional high stability time-base.

Both units provide unmatched value for money and offer a high degree of programmability through the GPIB/IEEE-488* interface. All major functions can be programmed with the PM 6665; and the PM 6666 offers 100% programmability including trigger level and sensitivity settings.

PM 6665

PM 6665

The PM 6665 timer/counter is specifically designed for applications with a small budget but a demand for a broad range of high performance counting and timing. It is low cost and offers the same high quality as other Philips test and measurement instruments. For example:

- Design is highly integrated, ensuring reliable, low power operation
- Stability is exceptional with Philips' MTCXO temperature compensated crystal oscillator, which delivers stability comparable to that of costly oven stabilized oscillators at the price level of a conventional TCXO
- An all-metal cabinet gives excellent RFI shielding and mechanical stability
- PM 6665 offers the best solution for both frequency and time measurements with its high quality inputs. Frequency measurements have continuously variable sensitivity and noise immunity and time measurements can be triggered within a wide ±5V/±50V range. A noise rejection filter is included as standard.

Optimal Time Measurements

The inputs for time measurements in the PM 6665 incorporate high speed synchronizers and equalized input channels to eliminate differences in delay and risetime. High sensitivity inputs reduce the possibility of trigger errors; trigger levels can be selected in the range from -50 to +50V and trigger indicators simplify level setting.

Frequency Measurements

Frequency measurements must have a variable noise immunity – which in practice means variable sensitivity – for correct triggering. On the PM 6665 this is accomplished with the continuously variable x1 ... x100 input signal attenuator.

Noise Rejection Filter Standard

The built-in noise rejection filter is useful for cleaning up noisy LF signals and for filtering off HF noise, even at levels higher than the input signal.

PM 6666

The PM 6666 is the first low cost timer/counter with high accuracy frequency, time and voltage measurements that also offers 100% programmable GPIB operation. With the GPIB bus, all measurement functions including trigger level settings and sensitivity can be programmed. A bus learn mode is provided to speed and simplify programming.

The PM 6666 is also an excellent all-purpose instrument for bench-top use, with 9 front panel selectable measuring functions including voltage max./min. measurements.

Time-out and separator settings are also programmable on both the PM 6665 and PM 6666 and a high speed mode delivers high-speed output of unformatted data at over 100 measurements/s. An optional rack mount adapter is available for both units for integration into measuring systems.

Error-Free Triggering

Triggering is error-free on the PM 6666 for all waveforms. Trigger-level setting can be automatic on all input signals over 100 Hz. Resolution

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** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

is 20/200 mV, over a very wide range (-50 ... +50V) that allows measurements to be accurate even on high voltage events. The trigger level can be displayed immediately with one keystroke; and inputs can be instantly checked for triggering with the tri-state LED trigger indicators.

To give the various noise immunity settings, input sensitivity has six steps, from 20 mV to 1 Vrms .

Peak Voltage Measurements to 50 MHz

The PM 6666 has a unique capability for an instrument in this price range, i.e. Vpeak measurements (-50...+50V) at up to 12 MHz at an error level of no more than a few percent. Vpeak measurements are possible over the range 12...50 MHz with slightly higher errors. When displaying Vmax./min. measurements, positive and negative signal peaks of the input signal are shown simultaneously with a resolution of 20/200 mV.

PM 6665 & PM 6666; Leading Technology

The latest technology is used in these timer/counters to give them their unrivalled performance for instruments in their price class.

Special emphasis was placed on reliability and integration to decrease the component count, which reduces heat dissipation and gives a high MTBF figure. For example, the entire counting logic circuitry consists of just two chips – the LSI counter-on-a-chip and a single chip control microcomputer. Also, a unique crystal oscillator is used for the timebase facilities – the MTCXO (see below). All this combines to give very powerful instruments in a small package and low price.

The PM 6665 and PM 6666 have high input protection, allowing them to withstand inputs of 12 Vrms on the optional 50 ohm RF input, and 350V (dc + ac peak) on the 1 Mohm LF input.

Unique MTCXO Timebase

Until now, choice of the timebase crystal oscillator, which determines the final accuracy of the counter, was only between the low-cost uncompensated standard crystal oscillators, medium price TCXOs (temperature compensated crystal oscillators) and high price, high stability oven-controlled oscillators.

Now, Philips has developed a mathematically compensated crystal oscillator which costs the same as a normal TCXO yet has a stability of 2 x 10^{-7} (0...50°C), comparable with that of an oven stabilized oscillator.

This new oscillator is called the MTCXO or Mathematically Temperature-Compensated Crystal Oscillator. It has an associated non-volatile memory in which are stored the frequency deviations from the factory measured temperature dependent frequency curve, at each temperature. During a measurement, the temperature of the crystal is measured, the deviation for that temperature is retrieved from the memory and the result is automatically compensated before display. In addition, because the temperature of the crystal is always compensated for each measurement, no warm up time is required for high accuracy measurement. Calibration is performed with the touch of a button, without warm-up.

High Resolution

Both PM 6665 and PM 6666 can measure low frequency signals to high resolution with synchronized multiple period measurements and computing the reciprocal values.

Resolution is at least 7-digits on a 1s measuring time, because the traditional ±1 input cycle error is eliminated by the built-in microprocessor. This high resolution applies to all input frequencies, whether high or low. Thus long gate times are no longer needed to obtain high resolution when measuring low frequency input signals. There is also no risk of instrument rounding error, because of the full 9-digit display.

Time interval measurements are high resolution as well as high accuracy, due to the time interval averaging technique. The 100 ns resolution is improved by a factor $\sqrt{N}$ (N + number of time intervals averaged) when compared with single time interval measurements. The maximum obtainable N is 4 x 10^7, resulting in a resolution of better than 20 ps.

Versatility for All-Purpose Use

Several variations and options are available so the user can chose exactly the configuration required for his application. The options are factory installed and tested in each user configuration. However, all options can also be field installed by the user allowing upgrading of the counter at any time.

The full range comprises:

- GPIB interface
- Highly stabilized timebase (MTCXO)
- 1.3 GHz HF input
- Battery power pack
- Rack mount kit
- Carrying case

Specifications

Measuring Functions

Frequency A or C (frequency B via GPIB only)

Range:
Freq A: 0.1 Hz...120 MHz: typically...160 MHz
Freq B: 0.1 Hz...12 MHz (via GPIB only)
Freq C: 70 MHz...1.3 GHz (optional)
Mode: Reciprocal frequency counting
LSD Displayed:

$$\frac{2.5 \times 10^{-7} \times \text{FREQ}}{\text{measuring time}}$$

RPM A (PM 6665 only)

A FREQUENCY A measurement is taken, multiplied by 60 and shown on the display as revolutions per minute (RPM).
Range: 6 RPM...720 x 10^6RPM

Period A

Range: 8 ns...2 x 10^8s
Mode: Single period measurement (SINGLE) or average period measurement (at 0.2, 1 or 10s measuring times)
LSD Displayed:
SINGLE period measurement: 100 ns (TIME <100s)
Average period measurement:

$$\frac{2.5 \times 10^{-7} \times \text{PERIOD}}{\text{measuring time}}$$

Ratio A/B (ratio B/A, C/A or C/B via GPIB only)

Range: 1 x 10^{-7}...2 x 10^9 (A/B);
1 x 10^{-8}...2 x 10^8 (B/A);
0...1 x 10^{15} (A/B SINGLE and B/A SINGLE);
8...6 x 10^{10} (C/A, C/B)
Frequency Range:
Input A: 0...120 MHz (A/B); 0...12 MHz (B/A, C/A, A/B SINGLE)
Input B: 0...12 MHz
Input C: 70 MHz...1.3 GHz

Time Interval A-B (time interval B-A via GPIB only)

Range: 100 ns...2 x 10^8s (SINGLE);
0 ns...20 s (average)
Mode: Single time interval (SINGLE) or average time interval measurements (at 0.2, 1 or 10s measuring times)
LSD Displayed:
SINGLE time interval measurements: 100 ns (TIME <100s)
Average time interval measurements:

$$\frac{2.5 \times 10^{-7}\text{s}}{N}$$

Averaged Number of Intervals N:

$$\frac{\text{measuring time}}{\text{pulse repetition time}}$$

Note: Input signals must be repetitive and asynchronous with respect to the time base.
Min Dead Time from Stop to Start: 250 ns
Timing Difference A-B Channels: 4 ns max.

Totalize A (totalize B via GPIB only)

Range: 0...1 x 10^{15} with indication of K or M (Kilopulses or Megapulses). The result is truncated if out of display range.
Frequency Range: 0 Hz...12 MHz
Pulse Pair Resolution: 80 ns
Gated by B (A) Mode: Event counting on input A (B) during the duration of a pulse on input B (A).
Start/Stop by B (A) Mode: Event counting on input A (B) between two consecutive pulses on input B (A).

PM 6665 & PM 6666

Manual Mode: Event counting controlled by the START/STOP button. Sequential start-stop counts are accumulated. RESET closes the gate and resets the timer/counter to zero.

Volt Max./Min. A, PM 6666 only (volt max./min. B via GPIB only)

Range: -51V...+51V
Frequency Range: DC and 100 Hz...50 MHz (input A);
DC and 100 Hz...5 MHz (input B)
Resolution:
Input signals within ±5V: 20 mV
Input signals outside ±5V: 200 mV
Inaccuracy DC and 100 Hz...12 MHz (A), or ...1 MHz (B):
Input signals within ±5V: 30 mV ±1% of reading ±3% of V_{pp}
Input signals outside ±5V: 300 mV ±3% of reading ±3% of V_{pp}
Inaccuracy 12 MHz...50 MHz (A) or 1 MHz... 5 MHz (B):
Input signals within ±5V: 30 mV ±10% of reading ±10% of V_{pp}
Input signals outside ±5V: 300 mV ±10% of reading ±10% of V_{pp}

Definitions

LSD Displayed

LSD = unit value of the least significant digit displayed. All calculated LSDs (see measuring functions section) should be rounded to the nearest decade (e.g. 0.3 Hz is rounded to 0.1 Hz and 5 Hz to 10 Hz) and cannot exceed the 9th digit.

Resolution

Resolution = smallest increment between two measuring results on the display, due to the ±1 count error.

Freq A, Freq C, Period A: Resolution can be 1 or 2 LSD if:

$$\frac{\text{LSD x measuring time}}{\text{FREQ or PERIOD}} < 10^{-7},$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).

Ratio A/B: Resolution can be 1 or 2 LSD. If:

$$\frac{\text{LSD x measuring time}}{\text{RATIO}} < \frac{10}{\text{FREQ A}}$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).

SINGLE Period A and SINGLE Ratio A/B: Resolution is 1 LSD
Time A-B: Resolution (95% confidence) = 1 LSD or 100 ns/√N, whichever is greater

Inaccuracy

Inaccuracy, i.e. the relative error, depends on the following factors:

$$\pm\frac{\text{Resolution}}{\text{FREQ, PERIOD RATIO or TIME}} \pm \text{relative trigger error}$$

± relative time base error
± relative systematic error

Relative Trigger Error:

Freq A, period A:

$$\pm\frac{\text{noise voltage A (Vpp)}}{\text{signal slope A (V/s) x meas. time}}$$

Ratio A/B:

$$\pm\frac{\text{noise voltage B (Vpp)}}{\text{signal slope B (V/s) x meas. time}}$$

Totalize A gated or start/stop by B:

$$\pm\frac{\text{noise voltage B (Vpp)}}{\text{signal slope B (V/s) x gate time B}}$$

Time A-B:

$$\pm\frac{\text{noise voltage A (Vpp)}}{\text{signal slope A (V/s) x TIME x }\sqrt{N}}$$

$$\pm\frac{\text{noise voltage B (Vpp)}}{\text{signal slope B (V/s) x TIME x }\sqrt{N}}$$

Relative Time Base Error:

$$\pm\frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$$

Relative Time A-B Systematic Error: Inaccuracy caused by timing difference between A and B channels <±4 ns/TIME

Input Specifications

Input-A and Input-B; PM 6665 only

Frequency Range:
DC-coupled: DC...120 MHz
AC-coupled: 20 Hz...120 MHz
Minimum Pulse Duration: 4 ns
Coupling: AC or DC
Impedance: 1 MΩ//35 pF
Channel Input: Separate A and B, or common via A
Maximum Voltage Without Damage: 350V (DC + ACpk) between 0 and 440 Hz, falling to 8 Vrms at 1 MHz.
Sensitivity; DC Coupled:
Sine: 20 mVrms, 0 Hz...100 MHz;
30 mVrms, 100 MHz...120 MHz
Pulse: 60 mVpp, 0 Hz...100 MHz;
90 mVpp, 100 MHz...120 MHz
Sensitivity decreases to 60 mVrms at 160 MHz typically
Sensitivity; AC Coupled:
Sine: 20 mVrms...200 mVrms at 20 Hz...100 MHz; 30 mVrms...300 mVrms at 100 MHz...120 MHz, continuously variable
Sensitivity decreases to 60 mVrms at 160 MHz typically
Filter: Switchable 50 kHz low pass noise filter with approx. 40 dB suppression at 1 MHz
Attenuation: x1 or x10
Trigger Slopes: Positive or negative
Trigger Level Range:
DC-coupled: +5V...-5V (x1); -50V...+50V (x10)
AC-coupled: 0V fixed
Trigger Indicators: Indication on LCD display when triggering on inputs A or B occurs.

Input-A and Input-B; PM 6666 only

Frequency Range:
DC-coupled: DC...120 MHz
AC-coupled: 20 Hz...120 MHz
Minimum Pulse Duration: 4 ns
Coupling: AC or DC
Impedance: 1 MΩ//35 pF
Channel Input: Separate A and B, or common via A
Maximum Voltage Without Damage: 350V (DC + ACpk) between 0 and 440 Hz, falling to 8 Vrms at 1 MHz
Sensitivity; DC Coupled:
Sine: 20 mVrms, 0 Hz...30 MHz;
40 mVrms, 30 MHz...120 MHz
Pulse: 60 mVpp, 0 Hz...30 MHz;
110 mVpp, 30 Hz...120 MHz
Sensitivity decreases to 60 mVrms at 160 MHz typically
Sensitivity; AC Coupled: Sensitivity is selectable in 6 steps; 20 mV, 50 mV, 100 mV, 200 mV, 500 mV and 1 Vrms (sine); nominal
Maximum sensitivity: 20 mVrms at 20 Hz...30 MHz; 40 mVrms at 30 MHz...120 MHz
Sensitivity decreases to 60 mVrms at 160 MHz typically
Attenuation: x1 or x10, switch selectable or AUTO
Trigger Slopes: Positive or negative
Trigger Level Range:
DC-coupled: -51V...+51V, adjustable via up/down control or AUTO
AC-coupled: 0V fixed or AUTO level
Trigger Level Resolution: 20 mV; signals within ±5V
200 mV; signals above ±5V
Trigger Level Setting Accuracy: ±10 mV ±1% of setting
AUTO Trigger Level: Trigger Level on input A (and B when required) is automatically set to 50% of input signal amplitude.
Frequency range: 100 Hz...120 MHz
Trigger Indicators: Tri-state LED indicators

Input C (Option PM 9608B)

Frequency Range: 70 MHz...1.3 GHz
Coupling: AC
Operating Input Voltage Range:
10 mVrms...12 Vrms, 70...900 MHz;
15 mVrms...12 Vrms, 900 ...1100 MHz;
40 mVrms...12Vrms, 1100...1300 MHz
AM Tolerance: 94% at max. 100 kHz modulation frequency; minimum signal must exceed minimum operating input voltage requirement
Input Impedance: 50Ω nominal, VSWR <2:1
Max. Voltage Without Damage: 12 Vrms, overload protection with pin diodes.

External Reference Input

Input Frequency: 10 MHz ±0.1 MHz
Coupling: AC
Sensitivity: 500 mVrms
Input Impedance: Approx. 300Ω at 10 MHz
Maximum Input Voltage: 15 Vrms

General Specifications

Power Requirements

Line Voltage: 115 or 230 Vrms ±15%; 46...440 Hz, <22 VA (PM 6665) resp. <24 VA (PM 6666) incl. all options
Safety: In accordance with IEC 348 Class I and CSA 556B
Line Interference: Below VDE 0871 B and MIL STD 461
Battery Unit: See PM 9605 option

Timebase

Oscillator version:	**Standard**	**MTCXO**
Stability against:		
Aging per month per year	 $<5x10^{-7}$ $<5x10^{-6}$	 $<1x10^{-7}$ $<5x10^{-7}$
Temperature changes 0...50°C	$<1x10^{-5}$	$<2x10^{-7}$
Line Voltage changes 10%	$<1x10^{-8}$	$<1x10^{-9}$

Display

Read Out: 9 digit LCD with unit and cursor indication
GATE Indicator: Indicates that the counter is measuring
REMOTE Indicator: Indicates when the counter is remotely controlled via an installed GPIB interface (PM 9604)

Environmental Conditions

Temperature:
Operating: 0°C...+50°
Storage: -40°C...+70°

Altitude:
Operating: 5000m (53.3 kN/m^2)
Storage: 15000m (15.2 kN/m^2)

Humidity:
Operating: 10%...90% RH, no condensation
Storage: 5%...95% RH

Dimensions and Weight

Dimensions: 186 mm W x 88 mm H x 270 mm L (7.3 in W x 3.5 in H x 10.6 in L)
Weight: 2.1 kg (4.6 lb)

Auxiliary Functions

RESET

The RESET button has three functions:
RESET: starts a new measurement. The settings are not changed.
LOCAL: makes the counter go to LOCAL operation, when in remote operation (unless Local Lock-Out is programmed).
START/STOP: opens/closes the gate in TOTALIZE A, manual mode.

Measuring Time

A measuring time of 0.2s, 1s, 10s or SINGLE can be selected

Display Hold

The current measuring result is frozen on the display. A new measurement starts when the RESET button is pressed.

Optional Accessories

GPIB Interface, PM 9604

Mounting: Inside counter cabinet
Interface Functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2
Programmable Device Functions:
Measuring functions
Measuring time
Trigger slope
Trigger levels (PM 6666)
Sensitivity (PM 6666)
Input coupling (PM 6666)
Input attenuator (PM 6666)
Manual totalize gate control
Output separator selection
Device clear
Device trigger
High speed dump
Short output format
Set time-out
Free run/triggered measurements
Set SRQ-mask
Program data out
Device identity
Max. Data Output Rate:
Normal Mode: Approx. 5 readings/s
High Speed Dump: Approx. 100 readings/s
The highest output rate is obtained at SINGLE measuring time.
High Speed Dump: The contents of the counting registers are transferred to the controller, without being processed by the counter. The processing must be done in the controller instead.
Output Time for Measuring Data:
Normal Mode: Approx. 9 ms (20 bytes)
High Speed Mode: Approx. 4 ms (15 bytes)
Response Time for Addressing: Approx. 1 µs
Response Time for Trigger Command (GET): Approx. 10 ms
Typical Read Time for Programming Data: Approx. 1 ms/byte

Battery Unit PM 9605

The PM 9605 is a rechargeable battery unit for mounting inside the counter. The unit contains a standard 6V sealed lead-acid battery and an automatic battery charger.
Battery Capacity (20°C): Approx. 15 Wh
Operating Time when Battery Powered: Approx. 2 hours of continuous operation
Recharging Time: 5 hours to approx. 75% of full capacity
Battery Protection: Overcharge protection and deep discharge (auto shut off) protection

Temperature:
Operating: 0...+40°C
Storage: -40...+50°C
Weight: 0.8 kg (1.7 lb)

Rack-Mount Kit HM 9606

The HM 9606 rack kit is designed for use with the PM 6665/6/9 family of counters. The HM 9606/01 allows mounting of one counter on the left of the rack and a blank panel on the right. The HM 9606/00 allows mounting of one counter plus one Fluke model 8840/2 or Philips PM 2534 or PM 2535 DMMs. The HM 9606 requires 5-1/4 inches of rack space. (See photo page 358.)

Carrying Case PM 9609

Included with the Instrument: Operating Manual, line cord

Ordering Information

Models

January 1989 prices

PM 6665 Timer/Counter	$895
PM 6666 Timer/Counter	995

Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit/suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface

Input Frequency Option:

/0-- Standard 120 MHz	N/C
/4-- 1.3 GHz (PM 9608B/00)	add 310

Reference Oscillator Option:

/-1- Standard	N/C
/-3- MTCXO (PM 9607/00)	add 240

Interface Option:

/--1 Standard line voltage, non GPIB IEEE-488	N/C
/--3 Battery (PM 9605/00)	add 245
/--6 GPIB IEEE-488 (PM 9604/00)	add 295

Example, Ordering Configurating
To order the PM 6666 with standard 120 MHz input, MTCXO Oscillator, and standard interface, select:

			Price
Model		PM 6666	$995
Configuration			
Option Suffix - Input		/0--	N/C
	Oscillator	/-3-	240
	Interface	/--1	N/C
Yields Complete Model Number		PM 6666/031	1235

PM 6665 & PM 6666

Options and Accessories

PM 9604/00* GPIB Interface	$295
PM 9605/00* Battery Unit	245
HM 9606/00 Rack Kit for PM 6665/6 and 8840/2 or PM 2534/35 DMMs	95
HM 9606/01 Rack Kit for PM 6665/6	90
PM 9607/00 MTCXO Timebase	240
PM 9608B/00 1.3 GHz HF-Input	$310
PM 9609 Carrying Case	75
PM 9581/01 50Ω Termination 3W	65
PM 9585/01 50Ω Termination 1W	30

All options can be field installed by the user.

** The GPIB interface PM 9604 and the battery unit PM 9605 cannot be installed together in a PM 6665/66 counter.*

Service and Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

7200 Series

7200 Series Counters

- Frequency measurement to 1300 MHz
- Single-shot time intervals to 10 ns
- Autoranging resolution for simple operation
- 100 kHz low-pass filter
- Fully EMI shielded
- Ovenized accuracy with battery portability

The 7200 Series consists of four counters, capable of measuring frequencies up to 1300 MHz, packaged in the versatile Portable Test Instrument case.

The 7220A Communications Counter provides frequency measurements to 1300 MHz. The 7250A Universal Counter/Timer is the lowest priced member of the family, and offers frequency, period, time interval, and totalizing measurements up to 80 MHz. The 7260A offers these same features, plus trigger hold-off and an optional Channel C for frequency measurements to 1300 MHz. The top-of-the-line 7261A adds increased resolution through a 100 MHz timebase, and offers a phase modulated time base to ensure valid time interval averaging of clock-synchronous signals.

The PTI Concept

The Fluke-developed Portable Test Instrument (PTI) packaging concept allows you to easily configure low-cost, convenient mini-test systems using the Fluke 1120A IEEE-488 Translator. A number of compatible Fluke instruments can be interfaced using the 1120A, including counters and voltmeters. With the 1120A, any PTI instrument cluster may be operated in a GPIB/IEEE-488* system. The unique stack-and-latch design makes them easy to carry; requires less rack space, too.

Low Susceptibility, Minimal rf Radiation

A lightweight, interval stainless steel shield completely surrounds the instruments and mates with the metal front and rear panels to provide an rf enclosure meeting most requirements of MIL-STD-461. This means low susceptability in high rf environments, as well as minimal radiated energy to interfere with nearby rf-sensitive equipment.

Portable Counters With Ovenized Accuracy

For applications demanding the best possible accuracy, ovenized timebase oscillators are available. These oscillators consume such low power they can be used when the counters are operating from batteries. When you go out on a field assignment you can switch to battery power and keep the oscillator warm and standing by for instantaneous use with laboratory stability and accuracy. There are two oven options to choose from, one with an accuracy of ±1 x 10^7, and one with an accuracy of ±3 x 10^8 over the 0°C to 40°C temperature range.

Simple, Hands-Off Operation

All counter/timer models (7250A, 7260A, 7261A) feature AUTO ranging resolution. Simply select the desired measurement function, set the resolution switch to AUTO range, and the instrument will automatically choose the correct range for best resolution, position the decimal point properly, and light an annunciator LED indicating the units of measurement.

7220 Communications Counter

The 7220A gives you 10 Hz to 1300 MHz coverage via two separate channels. Channel A is for low-frequency applications (10 Hz to 125 MHz), where the loading of the signal source and the effects of high frequency noise must be minimized. Channel B has a 50 ohm input and is for signals from 100 MHz to 1300 MHz.

An ac-coupled, 1 megohm input and versatile front-end controls for Channel A let you measure signals having extremely high noise levels and still produce stable, accurate readings. A continuously variable X1 to X10 wideband at tenuator plus switchable 1X or 10X attenuation lets you minimize noise without losing the signal. And a switchable 100 kHz low-pass filter solves the problem of high frequency contamination of audio frequencies. Used together, the attenuator and filter can solve most noise problems.

The resolution multiplier (Option -351) increases measurement resolution by a factor of 1000 for frequencies from 10 Hz to 10 kHz without requiring any more measurement time. Resolution goes from 0.001 Hz for 10 Hz signals to 0.1 Hz for 10 kHz signals.

7250A Universal Counter/Timer

The 7250A measures frequencies to 80 MHz, time intervals down to 100 ns, and periods down to 100 ns with 1 ps resolution (in the average mode). In addition it will measure the ratio of two signal frequencies, counts per minute, or totalize events to 9,999,999 counts.

A broadband, continuously variable, x100, analog attenuator lets you add just enough attenuation to minimize the input signal noise level and optimize the signal amplitude for count- ing. A switchable 100 kHz, lowpass filter solves the problem of high frequency contamination of audio signals. You can use the filter and attenuator separately or in combination to solve tough noise problems, like calibrating audio oscillators near high power rf transmitters. For timing measurements, there are ±slope controls, fixed-offset trigger level switches, and a separate/common switch at your fingertips.

7260A & 7261A Universal Counter/Timers

The 7260A and 7261A will measure frequencies to 125 MHz, or (optionally) to 520 MHz or 1300 MHz, with a 50Ω channel (Channel C).

The instruments are essentially alike except the 7261A has a 100 MHz clock, with a corresponding basic resolution of 10 ns, and the 7260A has a 10 MHz clock, with 100 ns resolution. Both counters will amke time-interval or signal-period measurement and will average from 10^0 to 10^5 such measurements per reading when greater resolution or accuracy is desired. That extends the resolution of the 7261A to 31.6 ps for time-interval measurements or to 0.1 ps for period measurements. In addition, the 7261A is available with a unique phase-modulated timebase option to assure averaging out small consistent errors.

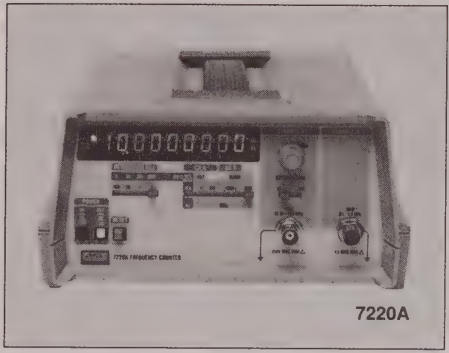
A broadband attenuator lets you select 1X, 10X or 100X attenuation to minimuze interference from signal noise and to trigger near the peak of high amplitude signals. And a switchable 100 kHz low-pass filter solves the problem of high frequency contamination of audio frequency signals. The signal may be dc coupled or ac coupled and weither + or - slope of the sign may be selected for triggering. The Channel A and Channel B trigger level controls have a zero-volt preset position for easy triggering on sinewaves and other signals that cross the zero-volt level.

Trigger status lights tell when triggering is unstable, and the precise trigger level setting of both channels may be monitored at a rear panel connector. Also at the rear panel is a marker output — a gate signal that brackets each period or time- interval measurement. The marker is for use with an oscilloscope. The trigger level and marker outputs are for making accurate timing measurements such as the rise time and fall time of complex signals. Atime interval hold-off control with a 1000:1 ratio (20 µs to 20 ms) delays the end of the marker gate to measure the precise protion of a signal.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

Benchtop Timer/Counters

7200 Series


7220A

7220A Specifications

Frequency Measurements

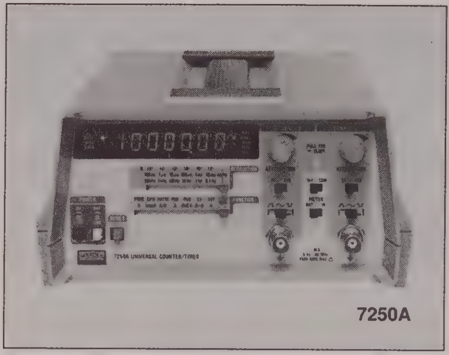
Channel A Range: 10 Hz to 125 MHz
Channel B Range: 100 MHz to 1300 MHz
Resolution: 0.1 Hz to 100 kHz in decade steps
Accuracy: ±1 count ± timebase error*
Display: MHz
Burst Mode: Minimum burst equals gate time +40 ms
**See Timebase Characteristics chart*

Channel A Input Characteristics

Bandwidth: 10 Hz to 125 MHz, ac-coupled
Sensitivity: 10 mV rms, 10 Hz to 50 MHz; 15 mV rms, 50 MHz to 100 MHz; 25 mV rms, 100 MHz to 125 MHz
Impedance: 1 MΩ, <60 pF
Filter: 100 kHz, low pass
Attenuator: X1 to X100; X1 or X10 fixed, plus X1 to X10 continuously variable
Maximum Input: 250V rms from 10 Hz to 5 kHz decreasing linearly from 250V rms at 5 kHz to 5V rms at 2 MHz; 5V rms from 2 MHz to 125 MHz

Channel B Input Characteristics

Bandwidth: 100 MHz to 1300 MHz
Sensitivity: 5 mV rms, 100 MHz to 600 MHz; 10 mV rms, 600 MHz to 1000 MHz; 40 mV rms, 1000 MHz to 1300 MHz
Impedance: 50Ω
VSWR: 2.5:1, maximum
Maximum Input: 5V rms


7250A

7250A Specifications

Frequency Measurements (CH A)

Range: 5 Hz to 80 MHz, ac coupled
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ±1 count ± timebase error*
**See Timebase Characteristics chart*

Period Measurements (CH A)

Range: 100 ns to 99,999.99 seconds
Frequency Range: 5 Hz to 1 MHz
Resolution: 10 ms to 100 ns in decade steps
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms, or sec with decimal

Period-Average Measurements (CH A)

Range: 1 ps to 999,999.9 µs
Frequency Range: 5 Hz to 1 MHz, sinewave
Resolution: 100 ns to 1 ps in decade steps
Accuracy: ±100 ns ÷ N* ± timebase error ± trigger error ÷ N*
Display: µs or ms with decimal
**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles of B averaged in ratio mode.*

Time-Interval Measurements (CH A/B)

Range: 100 ns to 99,999.99 sec
Frequency Range: 5 Hz to 1 MHz
Resolution: 100 ns to 10 ms in decade steps
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms or sec with decimal

Totalize

Range: 5 Hz to 80 MHz for channel A
Count Capacity: 9,999,999
Display: Digits only , no decimal or annunciator

Ratio Measurements

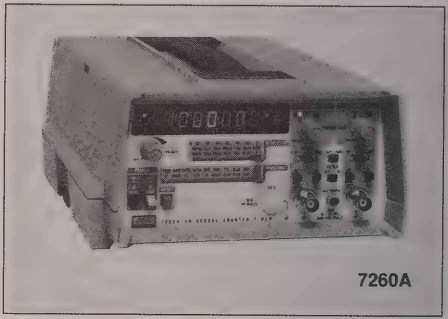
Range: 5 Hz to 80 MHz for channel A, 5 Hz to 1 MHz for Channel B
Resolution: ± frequency of B ÷ (N* x frequency of A)
Accuracy: ±Resolution ±(frequency of B x trigger error of B ÷ N*)
Display: Digits with decimal, no annunciator

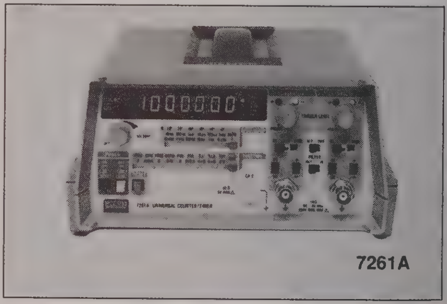
Counts Per Minute (cpm x 200,* CH A)

Range: 5 Hz to 80 MHz
Count Time: 600 ms (1/100 minute)
Resolution: 100 cpm, fixed
Accuracy: ± 1 count ± timebase error
Display: Digits only, no decimal or annunciator
**Reads RPM direct of 100-tooth wheel/sensor*

Channel A & B Input Characteristics

Selection: Separate or A connected to B (Sep/Com)
Sensitivity: 10 mV rms 5 Hz to 50 MHz, 15 mV rms, 50 MHz to 80 MHz
Impedance: 1 MΩ, 50 pF, nominal
Coupling: ac only
Attenuator: X 1 X 100, continuously variable
Filter: Low pass, 100 kHz 3 db point, nominal
Trigger Level: +150 mV, 0V, or -150 mV, 0V or -150 mV, switch-selectable
Maximum Input: 100V rms 5 Hz to 45 Hz, 250V rms 45 Hz to 50 kHz decreasing to 5V rms at 1 MHz to 80 MHz


7260A


7261A

7260A & 7261A Specifications

Technical Specifications

Frequency Measurements (Channel A)

Range: 0 Hz to 125 MHz
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ±1 count ± timebase error*
Display: kHz or MHz with decimal
**See Timebase Characteristics chart*

Frequency Measurements, Channel C Option (-310 or -331)

Range: 50 MHz to 520 MHz (Option -310); 100 MHz to 1300 MHz (Option -331)
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ±1 count ± timebase error*
Display: kHz or MHz with decimal
**See Timebase Characteristics chart*

Ratio Measurements (A/B)

Range: 0 Hz to 125 MHz for channel A, 0 Hz to 2 MHz for Channel B
Resolution: ± frequency of B ÷ N* x frequency of A
Accuracy: Resolution ± frequency of B x trigger error of B ÷ N*
Display: Decimal, no annunciator

Period Measurements (Channel A)

Range: 100 ns to 999,999.99 seconds for 7260A, or 10 ns to 99,999.999 seconds for 7261A
Frequency Range: 0 Hz to 2 MHz, sinewave
Pulse Width: ≥500 ns from 0 Hz to 100 kHz, ≥250 ns from 100 kHz to 2 MHz
Resolution: 10 ms to 100 ns in decade steps for 7260A, or 1 ms to 10 ns in decade steps for 7261A
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms, or sec with decimal for 7260A, µs, ms, or sec with decimal for 7261A

Period-Averaged Measurements (CH A)

Range: 1 ps to 9,999,999.9 µs for 7260A; 0.1 ps to 999,999.99 µs for 7261A
Frequency Range: 0 Hz to 2 MHz, sinewave
Pulse Width: ≥500 ns from 0 Hz to 100 kHz, ≥250 ns from 100 kHz to 2 MHz
Resolution: 100 ns to 1 ps in decade steps for 7260A; 10 ns to 0.1 ps in decade steps for 7261A
Accuracy: 100 ns ÷ N* ± timebase error ± trigger error ÷ N* for 7260A, or 10 ns ÷ N* ± timebase error ± trigger error ÷ N* for 7261A
Display: µs or ms with decimal
**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles averaged in ratio mode.*

Time-Interval Measurements (CH A/CH B)

Range: 100 ns to 999,999.99 sec, for 7260A, or 10 ns to 99,999.999 sec 7261A
Frequency Range: 0 Hz to 5 MHz, sinewave
Pulse Width: 250 ns, for 7260A, 210 ns for 7261A
Resolution: 100 ns to 10 ms in decade steps for 7260A, 10 ns to 1 ms in decade steps for 7261A
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms or sec 7260A; µs, ms, sec 7261A
Time Interval Holdoff: 20 µs to 20 ms, continuously variable

Time-Interval-Averaged Measurements (CH A/CH B)

Range: 1 ns to 9,999,999.9 +s for 7260A, or 0.1 ns to 999,999.99 µs for 7261A
Frequency Range: 0 Hz to 5 MHz, sinewave
Pulse Width: 250 ns for 7260A, 210 ns for 7261A
Resolution: 100 ns ÷ √N* for 7260A, 10 ns ÷ √N* for 7261
Accuracy: 100 ns ÷ √N* ±10 ns ± timebase error ± trigger error ÷ √N* for 7260A; 10 ns ÷ √N* ± timebase error ± trigger error ÷ √N* for 7261A
Dead Time: 4 µs
Display: µs or ms with decimal
**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles of B averaged in ratio mode.*

Totalize (CH A Gated by CH B)

Range: 0 Hz to 125 MHz for channel A, 0 Hz to 2 MHz for channel B
Count Capacity: 99,999,999
Display: Total count, no decimal or annunciator
Time Interval Holdoff: Range, 20 µs-20 ms, cont variable

Counts Per Minute (cpm x100, CH A)

Range: 0 Hz to 125 MHz
Count Time: 600 ms (1/100 minute)
Resolution: 100 cpm, fixed
Accuracy: ±1 count ± timebase error
Display: No decimal or annunciator

Channel A & B Input Characteristics

Bandwidth: 0-125 MHz, dc coupled; 5 Hz-125 MHz, ac coupled
Selection: Separate or A connected to B (Sep/Com)
Sensitivity: 10 mV rms, 0 to 50 MHz; 15 mV rms, 50 to 100 MHz; 35 mV rms, 100-125 MHz
Minimum Pulse: 50 ns at 50 mV pk (7260A); 10 ns at 50 mV pk (7261A)
Impedance: 1 MΩ, 50 pF, nominal
Coupling: ac or dc
Attenuator: X1, X10, X100, switchable
Slope: < or —, switchable
Filter: Low pass, 100 kHz 3 dB point, nominal
Trigger Level Range: +1.5V to -1.5V
Linear Operating Range: +2.5V to -2.5V
Maximum Input: 100V rms 0 Hz to 45 Hz, 250V rms 45 Hz to 50 kHz decreasing to 5V rms at 1 MHz, 5V rms 1 MHz to 125 MHz

Channel C Input Characteristics Option (-310 or -331)

Bandwidth: 50 MHz to 520 MHz (Option -310); 100 MHz to 1300 MHz (Option -331)
Sensitivity: 10 mV rms (Option -310); 5 mV rms to 600 MHz, 10 mV rms from 600 MHz to 1000 MHz, 40 mV rms from 1000 MHz to 1300 MHz (Option -331)
Impedance: 50Ω, 2.5: 1 VSWR, maximum
Maximum Input: 5V rms, fused

Triggering

Trigger Level Output: ±1.5V level indicates dc trigger level set on either Channel A or B, switch-selectable
Trigger Status Indicators: Two per channel provide positive indication that the input signal is triggering the input amplifier and relative indication as to where on the signal the input amplifier is being triggered
Cont/Trig Mode: Rear panel switch activates external trigger mode for initiating a measure ment

General Specifications

External Timebase Input

Frequency: 10 MHz, ac coupled
Sensitivity: 300 mV rms
Impedance: 1 kΩ, 30 pF, nominal
Maximum Input: 3V rms

Display: LED with leading zero suppression, decimal, and annunciators. 9-digits (7220A), 8-digits (7260A, 7261A), 7-digits (7250A)
Cycle Rate: Fixed 250 ms between readings
Reset: Reset button clears display, lights all display segments and, on release, activates a new measurement
Self Check: Counts and displays 10 MHz clock
Temperature: 0°C to 40°C, operating; -40°C to +70°C, non-operating
EMI: Internal metal RFI shield meets most re quirements of MIL-STD-461, Notice 3
Safety: Designed to meet requirements of UL 1244 and IEC 348
Power: 100V, 120V, 220V or 240V ac ±10%, 47 to 63 Hz, 32 VA max
Size: 32.7 cm L x 20.3 cm W x 10.8 cm H (12.9 in L x 8.0 in W x 4.3 in H)
Weight: 3 kg (6.5 lb), 7250A, 7260A, 7261A; 3.2 kg (7 lb), 7220A
Included: Instruction manual, power cord, serialized and dated calibration certificate

Option Specifications

Battery Pack Option (-010)

Type: Nickel-Cadmium, size F
Operating Time (Typical): 7220A, 5.5 hours; 7250A, 3.5 hours; 7260A, 2.8 hours, 7261A, 2 hours
Charge Time: 16 hours at room temperature
Charge Protection: Thermistor-actuated shut down of charging circuit if battery temperature exceeds 65°C
Discharge Protection: Automatic low-voltage shutdown to prevent over discharge

7200 Series

Timebase Characteristics

Characteristics	Option			
	Standard	-112 TCXO	-131 Oven	-132 Oven
Frequency	10 MHz	10 MHz	10 MHz	10 MHz
Aging Rate (Const Temp)	$\pm5x10^{-7}$ /mo	$\pm3x10^{-7}$ /mo* $\pm1x10^{-6}$ /yr	$\pm1x10^{-7}$ /mo*	$\pm5x10^{-8}$ /mo* $\pm3x10^{-9}$ /day*
Temperature Accuracy (0°C to 40°C)	$<5x10^{-6}$ **	$\pm2x10^{-6}$	$\pm1x10^{-7}$	$\pm3x10^{-8}$
Line Variation (±10% change)	$\pm1x10^{-7}$	$\pm2x10^{-8}$	$\pm2x10^{-8}$	$\pm4x10^{-9}$
Battery Operation	$\pm1x10^{-7}$	$\pm2x10^{-8}$	$\pm5x10^{-8}$	$\pm1x10^{-8}$
Warm-up 10 Minutes 20 Minutes	 — —	 — —	 $\pm5x10^{-7}$ $\pm3x10^{-8}$	 $\pm5x10^{-7}$ $\pm3x10^{-8}$

**After five days of continuous operation*

***Peak-to-peak variation over temperature range*

****Compared to frequency 24 hours after turn on*

(1) Timebase error is the sum of all errors specified for the particular timebase (see timebase specifications)

(2) Trigger error is the measurement error caused by noise on the input signal triggering the input amplifer too early or too late, calculated as follows:

$$\text{Microseconds of trigger error} = \frac{2 \times \text{pk noise voltage (V)}}{\text{signal slope at trigger point (V/}\mu\text{s)}}$$

or Trigger error + ±0.3% of one period divided by number of periods averaged for signals with better than 40 dB signal to noise ratio and 100 mV rms amplitude, whichever is greater.

Timebase Phase Modulation Option (-190) 7261A only

Description: Option insures valid time interval averaging of clock-synchronous signals by phase modulating internal timebase

520 MHz Channel C Option (-310) (7260A, 7261A)

Range: 50 MHz to 520 MHz
Sensitivity: 10 mV rms
Input Impedance: 50 Ohms
VSWR: 2.5:1, maximum

1300 MHz Channel C Option (-331) (7260A, 7261A)

Range: 100 MHz to 1300 MHz
Triggered Mode: Handles bursts as short as 3.6 ms
Sensitivity: 5 mV rms to 600 MHz, 10 mV rms from 600 MHz to 1000 MHz, 40 mV rms above 1000 MHz
Input Impedance: 50 Ohms
VSWR: 2.5:1, maximum
Maximum Input: 5V rms, fuse protected

Resolution Multiplier Option (-351) (7220A only)

Description: Frequency-locked loop circuit designed to increase low frequency resolution 1000 times
Range: 10 Hz to 10 kHz
Lock Time: 1.5 seconds
Resolution: 0.0001 Hz to 0.1 Hz in decade steps
Accuracy: ±2 counts ± timebase accuracy*
**See timebase characteristics for timebase accuracy*

Data Output Option (-521)

Type: Serial BCD output of all digits and measurement units
Levels: TTL, "1" state low

Personality Card Option (-522K)

For 1120A IEEE-488 Translator. Part of Option -529

IEEE-488 Interface Option (-529)

Description: Interfaces to IEEE-488 via the Fluke 1120A IEEE-488 Translator. (Note: 1120A must be purchased separately.) Provides full measurement output capability as well as remote selection of all functions and ranges.
Repertoire: SH1, AH1, T5, L4, SR1, RL2, DC1, DT1

Ordering Information

Models

January 1989 prices

7220A Communications Counter	$1525
7250A Universal Counter/Timer	1250
7260A Universal Counter/Timer	1575
7261A Universal Counter/Timer	1825

Options

All options may be ordered with all models, except as indicated.

72XXA-010* Rechargeable Batter Pack	475
7220A-111 1 ppm TCXO (7220A only)	210
72XXA-112* 2 ppm TCXO (7250A, 7260A, 7261A)	275
72XXA-131* Low Power Oven	350
72XXA-132* Superior Low Power Oven	575
72XXA-190** Timebase Phase Modulation	205
72XXA-310* 520 MHz Channel C (7260A, 7261A)	425
72XXA-331*** 1300 MHz Channel C (7260A, 7261A)	750
7220A-351* 1000X Resolution Multiplier (7220A only)	105
72XXA-521* PTI Interface w/PTI Cable	225
72XXA-522K Personality Card for 1120A	$250
72XXA-529 IEEE-488 Interface	425

**Factory or Service Center installation only.*

***Factory installation only.*

****Not compatible with Option -010. Also factory option only.*

[1] The -529 Option can be ordered and installed at time of manufacture only. Includes parts needed to interface the 7260A or 7261A to IEEE-488 via the Fluke 1120A IEEE-488 Translator. Includes -521, -522K, and Y7203 2 ft ribbon cable. For existing instruments which do not have the -529 Option installed, an IEEE interface can be added by ordering -521 and -522K Options (1120A also required).

Accessories (Also see page 485)

1120A IEEE-488 Translator	590
A53 Whip Antenna	30
Y7201 Attenuator/Filter	65
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω, BNC to BNC	20
Y9112 6 ft (1.85m) Coaxial Cable, 50Ω, BNC to BNC	20
Y9103 50ΩBNC Feed-thru Termination	35
Y2014 5" Rack Adapter, Single	95
Y2015 5" Rack Adapter, Double	95
Y2020 Panel Mounting Kit	95
Y7203 2 ft PTI Ribbon Cable	55
Y7204 5 ft PTI Ribbon Cable	70
Y2023 PTI Accessory Case	130

Service & Support

Warranty

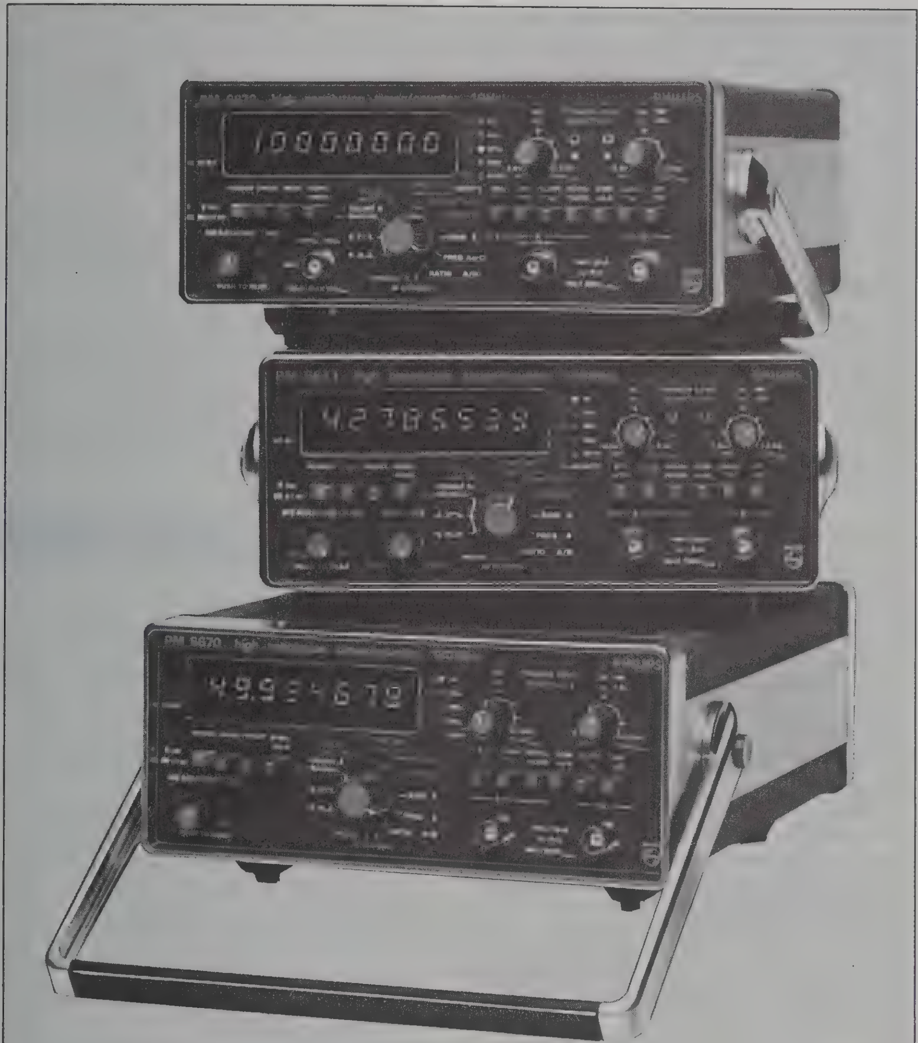
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-7220A Repair (w/calibration)	90
SC1-7220A Repair (cal w/in or out data)	105
SC1-7220A Repair (cal w/in and out data)	120
SC2-7220A Cal (1 per yr recommended)	45
SC2-7220A Cal (1 per yr w/in or out data)	60
SC2-7220A Cal (1 per yr w/in & out data)	75
SC1-7250A Repair (w/calibration)	95
SC1-7250A Repair (cal w/in or out data)	110
SC1-7250A Repair (cal w/in and out data)	125
SC2-7250A Cal (1 per yr recommended)	45
SC2-7250A Cal (1 per yr w/in or out data)	60
SC2-7250A Cal (1 per yr w/in & out data)	75
SC1-7260A Cal Repair (w/calibration)	114
SC1-7260A Repair (cal w/in or out data)	149
SC1-7260A Repair (cal w/in and out data)	184
SC2-7260A Cal (1 per yr recommended)	63
SC2-7260A Cal (1 per yr w/in or out data)	98
SC2-7260A Cal (1 per yr w/in & out data)	133
SC1-7261A Cal Repair (w/calibration)	138
SC1-7261A Repair (cal w/in or out data)	173
SC1-7261A Repair (cal w/in and out data)	208
SC2-7261A Cal (1 per yr recommended)	63
SC2-7261A Cal (1 per yr w/in or out data)	98
SC2-7261A Cal (1 per yr w/in & out data)	133

PM 6670, PM 6671 & PM 6672

GPIB
IEEE-488



PM 6672
PM 6671
PM 6670

PM 6670, PM 6671 & PM 6672 Reciprocal Timer/Counters
High resolution frequency measurements
GPIB/IEEE-488 option
High stability Crystal oscillators, up to 5 x 10^{-10}/24h
Time interval average with down to 10 ps resolution
High trigger accuracy
Excellent 10 mV sensitivity
Burst frequency average, Phase and RPM

These microcomputer-based timer/counters satisfy virtually all frequency and time measurement requirements. Their general purpose versatility, wide frequency range, high accuracy crystal oscillators and new powerful measuring features make them ideal for research and development applications.

Lightweight, compact construction results from the dramatically reduced number of components — down to only a few state-of-the-art LSI circuits, including a custom-designed counter-on-a-chip and a one-chip microcomputer. Philips advanced R & D capability allows size and cost reduction while still providing the ultimate in reliability and performance.

A choice of interfaces, including the GPIB/IEEE-488* bus puts this capability at the user's disposal for production and quality assurance testing. In addition, the optional battery unit extends the use of the instruments to field service applications.

Choice of Time Base Oscillator

The time base crystal oscillator determines the accuracy limit of the counters.

Note that even the most stable version (5 x 10^{-10}/24h) can be operated from internal batteries. This unique feature is achieved by specially developed oven-stabilized crystal oscillators with extremely low power consumption. Thus laboratory accuracy is now available for field applications — without irritatingly long warm-up times after changing location.

By means of the external reference input, the user's own frequency standard can be used when available.

High Resolution Computing Frequency Counting

By making a synchronized multiple-period measurement and computing the reciprocal value these timer/counters perform high resolution frequency measurements on all low frequency signals. The built-in microcomputer eliminates traditional ±1 input cycle errors and as a result gives at least seven digits resolution per second of measuring time. This avoids the need for long gate times, period measurements or phase-locked frequency multipliers, normally required to obtain a high resolution.

High Time Resolution

For time interval measurements these instruments also feature a very high measuring resolution. By using the time interval averaging technique, these timer/counters greatly improve both the measuring accuracy and resolution.

Compared to single time interval measurements, the basic 100 ns resolution is improved by a factor of $\sqrt{N}$, where N is the number of time intervals being averaged.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 6670, PM 6671 & PM 6672

With the PM 6670/71/72, N can be more than 10^8. The resolution then becomes:

$$\frac{100\ \text{ns}}{\sqrt{10^8}} = 10\ \text{ps}$$

High Trigger Accuracy...

Ultimately, no counter is better than its front-end circuitry. Therefore the PM 6670 series employs the best front-end circuit concept available.

These timer/counters feature special input signal conditioning configurations, which are optimized for both frequency and time interval measurements, e.g. either adjustable trigger levels for time interval measurements or adjustable sensitivity and noise immunity for frequency measurements.

...for Time Measurements

Meaningful use of the averaging technique is made through the high-speed synchronizers and equalized input channels. Amplifiers and Schmitt-trigger circuits for both start and stop channel are all on the one IC-chip, thereby avoiding differences in delay and rise times. This reduces systematic trigger errors which cannot be eliminated by averaging.

Systematic trigger errors are further reduced by the low hysteresis via the use of high sensitivity input amplifiers, as shown in the counter's introduction section.

The PM 6671 and 6672 feature trigger level outputs on the front panel, allowing accurate measurements to be made of the set trigger level with a DVM. The trigger level can also be positioned accurately with respect to the waveform using an oscilloscope.

...for Frequency Measurements

For frequency measurements, the trigger control can be selected to act as a wide-band, continuously variable input attenuator (x1...x100) to allow optimum matching of trigger sensitivity and noise immunity.

Noise Rejection Filter

To obtain full benefit from the high resolution reciprocal design, noise and interference can be excluded by a switchable built-in noise-rejection filter for low frequency measurements. This filter even rejects HF noise or interference that is stronger than the input signal itself.

Automatic Triggering on RF Signals

The 1 GHz model PM 6672 has a special RF input with front-end circuits that feature advanced RF techniques, including automatic PIN-diode attenuators that bring a number of user benefits:

- Automatic triggering
- Excellent overload protection; 12 Vrms
- High AM tolerance: up to 98%
- Wide dynamic range: 15 mVrms...12 Vrms

RFI Suppression

Effective precautions have been taken to reduce radiation and susceptibility to radio frequency interference (RFI) to minimum levels. For example, all the counters are encased in sturdy metal cabinets, which provide excellent RFI shielding. Reduction of RFI radiation far below the most severe requirements, including VDE 0871 (B) and MIL STD 461, contributes to the superior accuracy of these models.

Variable Measuring Time

A valuable microcomputer benefit is the continuously variable measuring time, which is no longer limited to decade steps. It is possible, for example, to select a measuring time of 2.4 seconds if one second does not give sufficient resolution. This avoids the need to switch directly to a time-wasting 10 second measurement period.

Phase and RPM

Another microcomputer benefit in these timer/counters is the possibility of new measuring functions — such as phase and RPM (revolutions/minute) — which are not normally found in counters.

A simultaneous measurement of period duration and the phase delay between two signals allow the microcomputer to calculate and display phase delays directly in degrees.

Trigger Hold-Off and Arming

The PM 6671/6672 give full control over the start conditions of a measurement. With an external gate signal, one can prevent the timer/counter from triggering on the first input signal.

Another useful feature, found on the PM 6671 is trigger hold-off, which avoids false stop triggering on spurious or unwanted signals. A typical example is the pulses from relay contact bounce (see fig. 1).

Trigger Indicators

Tri-state trigger indicator LEDs on the PM 6671 and PM 6672 facilitate quick setting of the trigger level. LEDs for channel A and B blink to indicate that these inputs are triggered. Lights on/off indicate that the trigger level is too low/high. This feature is of great help, particularly when making time interval measurements, where both channels have to be triggered correctly.

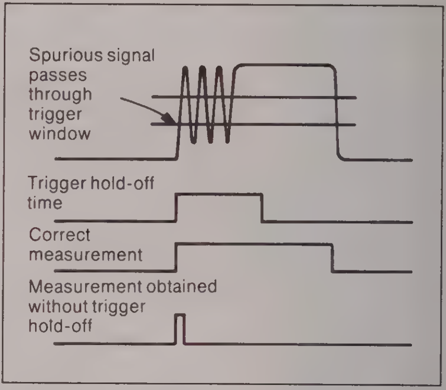

Spurious signal passes through trigger window
Trigger hold-off time
Correct measurement
Measurement obtained without trigger hold-off

Fig. 1. The use of the PM 6671 variable trigger hold-off enables the influence of spurious signals such as ringing or relay bounce to be ignored and correct measurements obtained.

Specifications

Measuring Modes

Frequency

Range: 0.1 Hz...120 MHz (all models); 0.1 Hz...1 GHz (PM 6672)
Mode: Input signal synchronized, high resolution computing measuring method (reciprocal).
Signal Mode: CW, SINGLE BURST, MULTIPLE BURST FREQUENCY AVERAGE
LSD Displayed: 10^{-7} Hz...10^{3} Hz (PM 6670, 6671). 10^{-7} Hz...10^{4} Hz (PM 6672), depending on measuring time and input frequency. At least 7 digits displayed per second of measuring time.
Resolution: LSD*
Inaccuracy (rel. error):

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \frac{\text{trigger* error}}{\text{measuring time}}$$

± rel. time base error

Period Average

Range: 100 ns...100s
***LSD Displayed:** 10^{-15}...10^{-6}s, depending on measuring time and period duration. At least 7 digits displayed per second of measuring time.
Resolution: LSD*
Inaccuracy (rel. error):

$$\pm\frac{\text{resolution}}{\text{PERIOD}} \pm \frac{\text{trigger* error}}{\text{measuring time}}$$

± rel. time base error

**See definitions*

Time Interval A to B; Single

Range: 100 ns...10^8s
LSD Displayed: 10^{-7}s...10^0s
Resolution: LSD*
Inaccuracy (rel. error):

$$\pm \frac{\text{resolution} \pm \text{trigger* error}}{\text{TIME INT}}$$

± rel. time base error

Pulse Width A

Pulse width measurements are similar to single time interval measurements. Both start and stop triggering take place in channel A, with common trigger level setting and automatic trailing edge trigger slope inversion with respect to selected leading edge trigger slope.
All other specifications are identical to single time interval. High resolution, pulse width measurements on narrow pulses can be made in the time interval average mode with manual selection of common source and stop slope polarity.

Time Interval A to B; Average

Range: 0 ns...100s
LSD Displayed: 10^{-15}s...10^{-6}s, depending on measuring time and time interval.
Resolution:

$$\frac{10^{-7}\text{s}}{\sqrt{N}} \text{ or 1 LSD unit, whichever is greater}$$

Inaccuracy (rel. error):

$$\pm \frac{4\text{ ns} \pm \text{resolution}}{\text{TIME INT}} \pm \frac{\text{trigger* error}}{\sqrt{N} \times \text{TIME INT}}$$

± rel. time base error.

Number of Intervals Averaged (N): Measuring time x interval repetition rate.
Minimum Dead Time from Stop to Start: 300 ns

Note: Input signal must be repetitive and asynchronous with respect to the time base.

Count A

Totalize Range: 1...10^{17}, with indication of M-pulses and G-pulses beyond the 10^8 display range.
Pulse Pair Resolution: 80 ns
Mode:
Manual: Start-stop by DISPL. HOLD push button. Sequential start-stop periods are accumulated or individually totalized after reset.
External: Totalizing interval controlled via input B, selectable: count A gated during pulse duration on B or count A gated between start and stop pulse on B.
Inaccuracy: Pulse repetition rate A x trigger* error B.

Phase A-B

Phase is the result of a simultaneous time interval average and period average measurement. The maximum phase range is therefore limited, due to the 300 ns dead time between stop and start of the next time interval, and consequently frequency dependent. For phase measurements between 180° and 360° on high frequency signals, measure the complementary phase 0°...180° by changing the input leads (phase B to A).
Phase Range:
0.1°...360° x [1-(300 ns x FREQ)]
Example: 0.1°...359.995° at 50 Hz
0.1°...357.3° at 25 kHz
0.1°...180° at 1.666 MHz

Frequency Range: 0.03 Hz...1.6 MHz
LSD Displayed: 10^{-6}...10^{-2} degrees, depending on measuring time and phase difference.
Resolution:

$$\frac{10^{-7}\text{s} \times \text{FREQ} \times 360°}{\sqrt{N}}$$

Inaccuracy (rel. error):

$$\pm \frac{4\text{ ns} \times 360° \times \text{FREQ}}{\text{PHASE}} \pm \frac{\text{resolution}}{\text{PHASE}}$$

$$\pm \frac{\text{trigger* error} \times \text{FREQ} \times 360°}{\sqrt{N} \times \text{PHASE}}$$

Number of Input Cycles Averaged (N): Measuring time x FREQ A.
Minimum Input Signal: 100 mVrms
Phase Jitter Tolerance: The tolerated phase jitter peak-value ≤ phase difference, i.e. phase jitter around 0° should not cause consecutive measurement results of slightly above 0° and slightly below 360° since the total measurement results is the statistical average of all individual results.

Ratio

Range: $\frac{\text{FREQ A}}{\text{FREQ B}} = \frac{0...10\text{ MHz}}{0...10\text{ MHz}}$ (all models)

LSD Displayed: 10^{-7}...10^0
Resolution: LSD*
Inaccuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{RATIO}} \pm \text{rel. trigger* error B}$$

Note: Frequency ratio measurements

$$\frac{\text{FREQ A (or C)**}}{\text{FREQ D}} = \frac{0.1\text{ Hz...120 MHz(or 1 GHz)**}}{50\text{ kHz...10 MHz}}$$

can also be made in the frequency mode, by making use of the external reference input D. However, this arrangement does not give correct decimal points.

RPM

The RPM (revolutions per minute) mode is similar to the frequency mode. The measured frequency is multiplied x 60 before being displayed.
Range: 0.6 RPM...10^8 RPM (with one pulse per revolution).
LSD Displayed: 10^{-7} RPM...10^0 RPM, depending on measuring time and RPM.
Resolution: LSD*
Accuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{RPM}} \pm \frac{\text{trigger* error}}{\text{measuring time}}$$

± rel. time base error

Auxiliary Functions

Measuring Time

The measuring time is "continuously" variable (33 steps/decade): 10 ms...96s, with clear set-points at 10 ms, 100 ms, 1s, 10s and 96s. Selected measuring time is displayed, without any delay, when depressing the measuring time control.

Hold-Off

With trigger hold-off activated, the counter ignores retriggering (channel A) or stop triggering (channel B) during the set hold-off time. The hold-off time can be digitally measured by pressing CHECK.
Applicable in all time modes.
Range: 200µs...200 ms, in period, time interval and pulse width mode, the set hold-off time is visible with CHECK depressed.
On/Off Indication: LED indicates when hold-off is activated.
Monitor: The selected hold-off duration can be made visible via the gate monitor output.

On/Stand By

In "ST BY" position, power is available to maintain an ovenized crystal oscillator heated and to recharge the optional battery pack.

Check

10 MHz internal reference connected to logic circuitry. Self-test of most measuring functions can be selected. By using this mode, the COUNT function provides a stop-watch facility.

Display Hold

Depressing "DISP HOLD" button sets display time to infinite and freezes the last measurement result. A new measurement can be initiated using reset.
In the COUNT mode, the "DISP HOLD" control is used to start and stop manual totalizing.

Reset

Manual via push button or electrical via input E.

Input and Output Specifications

Inputs A and B

Frequency Range: *DC coupled:* 0...120 MHz; *AC coupled:* 50 Hz...120 MHz
Rise Time: Approx. 4 ns
Sensitivity:
DC coupled: 10 mVrms sinewave or 30 $\text{mV}_{\text{p-p}}$ (0...75 MHz), 20 mV rms sinewave or 60 $\text{mV}_{\text{p-p}}$ (75...120 MHz)
AC coupled: 10 mVrms...100 mVrms sinewave (0...75 MHz), 20 mVrms...100 mVrms sinewave (75...120 MHz)

**See definitions*
***C only on PM 6672*

PM 6670, PM 6671 & PM 6672

Attenuation: x 1/x 10 fixed.
For frequency related measurements, the fixed attenuator can be used in combination with the continuously variable attenuator x 1...x 10 (AC coupled position).
Noise Immunity/Hysteresis Band:
DC coupled: approx. 20 mV$_{p-p}$/200 mV$_{p-p}$
AC coupled: approx. 20 mV$_{p-p}$...2V$_{p-p}$
Dynamic Input Voltage Range:
DC coupled: 30 mV$_{p-p}$...5V$_{p-p}$/ 300 mV$_{p-p}$...50V$_{p-p}$
AC coupled: 10 mVrms...2 Vrms/100 mVrms... 20 Vrms
Trigger Level:
DC coupled: -2.5V...+2.5V/-25V...+25V
AC coupled: fixed 0V; level control acts as continuously variable attenuator, which is more suitable for frequency related measurements.
Trigger Level Output: Set trigger voltage -2.5V ...+2.5V, available on 1 mm jacks at the front for monitoring of set trigger level. (Not available on PM 6670).
Trigger Indicators: Tri-state LED trigger lights to indicate trigger status:
Coupling: DC/AC
Impedance: Approx. 1 MΩ//35 pF, independent of sep/com switch position.
Channel Input: Separate A and B or common A
Noise Filter: Switchable 50 kHz Low pass filter in channel A. Noise suppression approx. 40 dB at 1 MHz.
Maximum Voltage Without Damage:
DC: 300V
AC: 260 Vrms at ≤440 Hz declining to 12 Vrms at ≥1 MHz (in ATT x 1 position), 260 Vrms (in ATT x 10 position).

Input C (PM 6672 only)

Frequency Range: 70 MHz...1 GHz
Operating Input Voltage Range: 15 mVrms... 12 Vrms (70 MHz...800 MHz).
25 mVrms...12 Vrms (800 MHz...1 GHz).
Impedance: 50Ω nominal; VSWR <2
Coupling: AC
AM Tolerance: 98%; minimum signal must exceed minimum operating input voltage.
Maximum Voltage Without Damage: 12 Vrms; overload protection with PIN diodes.

Ext. Reference and Ratio Input (Ch. D)*

Frequency Range: 50 kHz...10 MHz
Sensitivity: 500 mVrms
Impedance: Approx. 2 kΩ
Coupling: AC
Max. Voltage Without Damage: 25 Vrms

Note: as external reference frequency, only 10 MHz will give correct decimal point and unit indication. With the optional frequency multiplier PM 9697 references of 1 and 5 MHz can also be accepted.

Internal Standard Output (Ch. D)*

Crystal Frequency: 10 MHz
Output Level: LS-TTL compatible
Output Impedance: Approx. 400Ω
Coupling: DC
Overload Protection: Short circuit proof

Ext. Arming/FREQ-Avg/Reset (Ch. E)*

A 3-position rear panel switch gives choice of external control over:
Arming: In this position, the counter is prevented from starting a new measurement when input E is high. A high-to-low going pulse arms the counter to start a new measurement.
Note: Arming not applicable in COUNT A, manual mode.

Frequency Average: Frequency measurements (max. 100 MHz) and period measurements are interrupted when input E is high. The measurement is continued again when input E is low. Each individual frequency sample must contain at least 20 pulses (FREQ mode) or 2 pulses (PERIOD mode).
The effective measurement time (defining resolution and accuracy) is the sum of external gate times that occurs during the selected measurement time.
Ext. Reset-Start: Electrical reset, equivalent to the front panel RESET push button. (See HOLD and RESET). Counter is reset when input E goes high. A new measurement can be made after input E has returned low.
Input Levels: High: ≥2V; Low: ≤0.5V
Input Impedance: Approx. 2 kΩ
Max. Input Voltage Without Damage: ±25V
Minimum Pulse Duration: Arming and frequency avg.: 500 ns; External reset: 200 µs

Gate Monitor Output (Rear)

The gate status monitor output permits observation on an oscilloscope of the measured time interval and the trigger hold-off time (PM 6671 only).
Output Level: Main gate open: approx. 0.4V;
Hold-off active: approx. 1.2V;
Main gate closed: approx. 2.5V
Output Impedance: Approx. 1.5 kΩ
Delay: Internal dealy between actual triggering and gate monitor output is approx. 150 ns.
Overload Protection: Short circuit proof

General Specifications

Time Base

For specifications, see table on following page.

Display

Readout: 8 digits, 7.6 mm high-efficiency LEDs. Microprocessor control of display format, decimal point and unit indication: Hz, kHz, MHz, GHz, ns µs, ms and s.
Display Time: Continuously variable 80 ms... 96s plus DISP HOLD.
Gate Lamp: Indicates that main-gate is opened and measurement takes place.
ST BY: Stand-by indication with LED when instrument is not switched ON.
REMOTE*: Indicates when control over counter is taken by the installed BUS interface option (IEC 625-IEEE 488).
Low-Battery*: Indication by blinking display some 15 min. before recharging is needed.

Power Requirements

In addition to the normal line voltage supply, the PM 6671 and PM 6672 can also be powered from an optional battery pack or external DC voltage.
Line: 115/230V ±15%; 45...440 Hz; <25 VA
Internal Battery Unit*: PM 9693
External DC Source: 11.8V...28V
Line Interference: Below VDE 0871 (B) and MIL STD 461
Safety: According to IEC 348 and CSA 556 B

Dimensions and Weight

Dimensions: 210 mm W x 89 mm H x 280 mm L (8.25 in W x 3.8 in H x 11 in L)
Weight: 2.5 kg (5.5 lb)

Environmental Conditions

Temperature
Rated Range of Use: -5°C...+50°C
Storage and Transport: -40°C...+70°C
Humidity
Operating: 10...90% RH, no condensation.
Storage: 5...95% RH.
Altitude/Barometric Pressure
Operating: 5000m (15000 ft) -53.3 kN/m²
Storage: 15000m (50000 ft) -15.2 kN/m²

Definitions

LSD Displayed

Unit value of least significant digit, displayed.

For FREQUENCY, PERIOD AVERAGE, RPM and PHASE

$$\text{LSD} = \frac{2.5}{\text{measuring time}} \times \frac{\text{FREQ or PERIOD or RPM or } 360°}{10^{-7}\ \text{Hz}}$$

For RATIO

$$\text{LSD} = \frac{2.5 \times \text{prescaling factor (P)} \times \text{RATIO}}{\text{measuring time} \times \text{FREQ A or C}}$$

(P) + 1 Channel A, all models
(P) + 256 Channel C, PM 6672

For SINGLE TIME INTERVAL and PULSE WIDTH

LSD = 100 ns (for times <10s).

$$\text{LSD} = \frac{5 \times \text{TIME}}{10^{8}} \text{ (for times >10s)}$$

**Not available on PM 6670*

PM 6670, PM 6671 & PM 6672

For TIME INTERVAL AVG

$$\text{LSD} = \frac{2.5 \times 10^{-7}\text{s}}{\text{meas. time} \times \text{time int. rep. rate in Hz}}$$

All calculated LSDs shall be rounded to nearest decade (e.g. 5 ns will be 10 ns and 0.4 Hz will be 0.1 Hz) and cannot exceed the 8th digit.

Resolution

For Multiple Event Measurements:
FREQUENCY, PERIOD AVERAGE, RPM AND RATIO, the resolution is the smallest increment between two measuring results, being most often 1 LSD unit. Due to arithmetic truncation, the resolution can be 2 LSD units if:

$$\frac{\text{LSD} \times \text{measuring time}}{\text{FREQ or PERIOD or RPM or RATIO}} < 10^{-7}\text{s}$$

but can then be reduced to 1 LSD unit, by doubling the measuring time.

For Single Event Measurements:
PULSE WIDTH and SINGLE TIME INTERVAL, the measuring resolution is 100 ns (one clock pulse). The counter can accumulate up to 10^{15} clock pulses, of which only the 8 most significant digits are shown.

For Statistical Measurements:
TIME INTERVAL AVERAGE and PHASE, the measuring resolution is the smallest increment between two measuring results, with confidence level of 95%.

Trigger Error

Trigger error is the absolute measurement error due to noise on the input signal causing a too early or too late triggering.

For any Waveform (FREQ, PERIOD, RATIO, RPM and PULSE WIDTH):

$$\frac{\text{peak-to-peak noise voltage}}{\text{signal slope (V/s)} \times \text{measuring time}}$$

For Sinewave (FREQ, PERIOD, RATIO, RPM):

$$\frac{1}{\text{FREQ} \times \pi \times \text{S/N ratio}}$$

Example: For S/N ratio of 100 (40 dB) and 1 second measuring time, the trigger error is:

$$\frac{3 \times 10^{-3}}{\text{FREQ}}$$

For Separate Source TIME INTERVAL:

$$\pm \frac{\text{peak noise voltage (input A)}}{\text{signal slope A (V/s)}} \pm \frac{\text{peak noise voltage (input B)}}{\text{signal slope B (V/s)}}$$

For PHASE:

$$\frac{1}{\text{FREQ} \times 2\pi} \times \left(\frac{1}{\text{S/N ratio (input A)}} \pm \frac{1}{\text{S/N ratio (input B)}}\right)$$

Note: S/N ratios calculated with peak-to-peak signal and noise values.

Crystal Oscillator Summary

PM 66../...Version Including Time Base Option	/.1. Standard Version	/.2. Version PM 9678	/.3. Version PM 9679	/.4. Version PM 9690	/.5.Version PM 9691
Stability Against	Standard	TCXO	Oven	Oven	Oven
Aging:/24h /Month /Year	N/A $<5 \times 10^{-7}$ $<5 \times 1^{-6}$	N/A $<1 \times 10^{-7}$ $<5 \times 10^{-7}$	N/A $<1 \times 10^{-7}$ $<5 \times 10^{-7}$	$<1.5 \times 10^{-9}$* $<3 \times 10^{-8}$ $<1.5 \times 10-7$	$<5 \times 10^{-10}$* $<1 \times 10^{-8}$ $<7.5 \times 10^{-8}$
Temperature: 0°C to 50°C Ref. to +23°C	$<1 \times 10^{-5}$	$<1 \times 10^{-6}$	$<1 \times 10^{-7}$	$<3 \times 10^{-8}$	$<5 \times 10^{-9}$
Change in supply Mode: line/int. battery /ext. DC 12V to 28V	$<3 \times 10^{-7}$	$<5 \times 10^{-8}$	$<1 \times 10^{-8}$	$<3 \times 10^{-9}$	$<3 \times 10^{-9}$
Line Voltage:±10%	$<1 \times 10^{-8}$	$<1 \times 10^{-9}$	$<1 \times 10^{-9}$	$<5 \times 10^{-10}$	$<5 \times 10^{-10}$
Warm-up time to reach 10^{-7} of final value	N/A	N/A	<10 min	<15 min	<15 min

**After 48 hours of continuous operation.*

Interface Data

IEEE interface option PM 9696: Can be supplied fitted (to order), or retrofitted in the field.
Connector: 24-pole: address set by switches
Output Data: Measuring data including function code, overflow and range. Status data, generated at serial poll or after instruction, including full programming status data and function status
Output Rate: 10...20 readings per second
Input Data: Programing data for all manually controllable functions except input trigger functions

Included with Instrument: Operator's manual, line cord

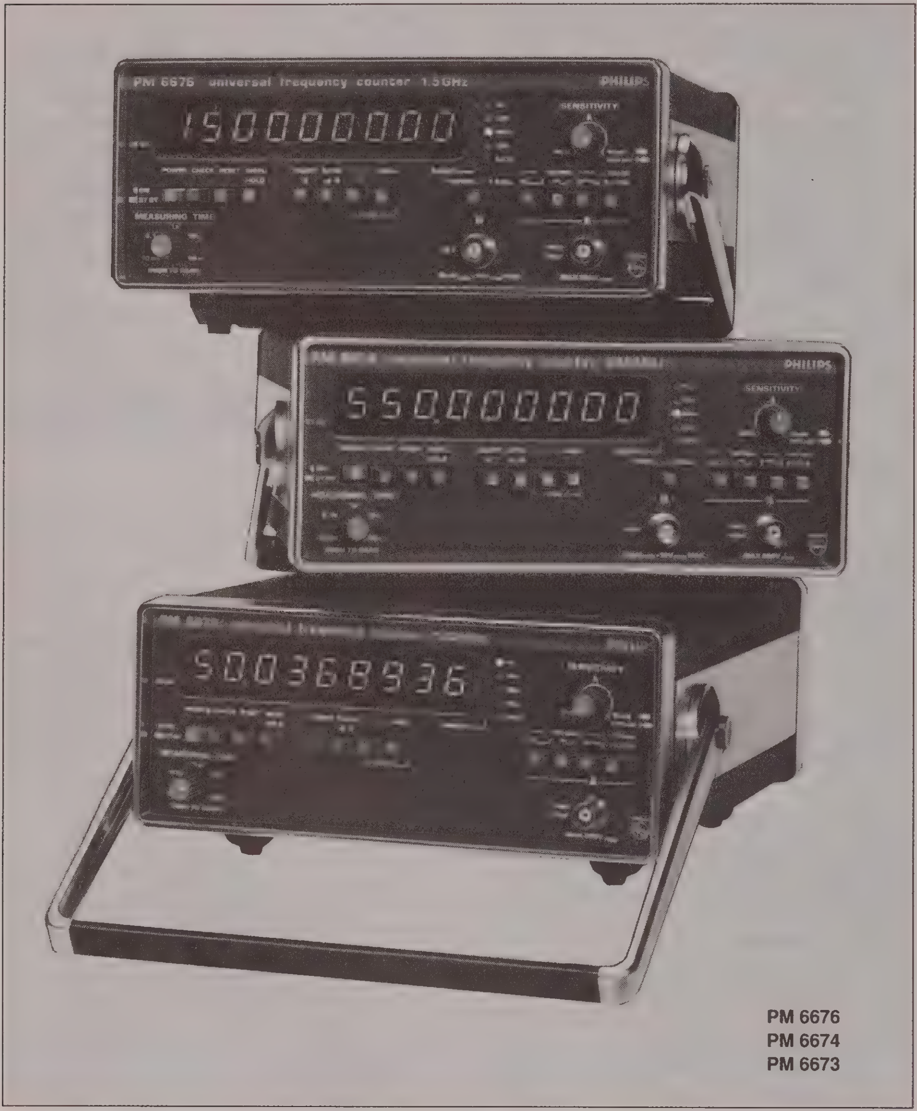
Ordering Information

Models

For ordering information, see counter models PM 6673 - PM 6676, page 351

PM 6673, PM 6674, PM 6675 & PM 6676

GPIB
IEEE-488



PM 6676
PM 6674
PM 6673

PM 6673-PM 6676 High Resolution Universal Frequency Counters

- High resolution frequency measurements
- Error-free triggering
- High stability crystal oscillators up to 5 x 10^{-10}/24h
- Programmable via GPIB/IEEE-488 option
- High 10 mV sensitivity
- Multiple burst frequency average
- BCD or analog output

These microcomputer-based universal frequency counters satisfy virtually all frequency measurement requirements. Their high accuracy concept, wide frequency ranges and new powerful measuring features make these counters ideal for research and development of telecommunication, broadcast, TV, radio control and navigation equipment.

Lightweight, compact construction results from the dramatically reduced number of components — down to only a few state-of-the-art LSI circuits, including a counter-on-a-chip and a one-chip microcomputer. Philips' advanced R & D capability yields reduction in size and cost while still providing the ultimate in reliability and performance.

A choice of interfaces, including the GPIB/IEEE- 488* bus puts this capability at the user's disposal for production and quality assurance testing. In addition, the optional battery unit extends the use of the instruments to field service applications.

High Resolution Computing Counting

By making a synchronized multiple-period measurement and computing the reciprocal value, the counters perform high resolution frequency measurements on all low frequency signals. The built-in microcomputer eliminates traditional ±1 input cycle errors and as a result gives at least seven digits resolution per second of measuring time. This avoids the need for long gate times, period measurements or phase-locked frequency multipliers, normally required to obtain a high resolution. Above 10 MHz, the conventional counting method is automatically selected, to give improved resolution at the higher frequencies (see fig. 1).

Error-Free Triggering

Ultimately, no counter is better than its front-end circuitry. Therefore the PM 6670 series employs the best front-end circuit concept available. The wideband, continuously variable input attenuator allows optimum matching of trigger sensitivity and noise immunity over a wide dynamic range from 20 mV_{pp} to $10V_{pp}$. See introduction of the counter section.

To obtain full benefit from the high resolution reciprocal design, meaningless digits can be excluded by a switchable built-in noise-rejection filter for low frequency measurements. This filter even rejects HF noise or interference that is stronger than the input signal itself.

Automatic Triggering on RF Signals

The UHF counter models PM 6674, 6675 and 6676 have special RF inputs up to 550 MHz, 600 MHz and 1.5 GHZ respectively. Their front-end circuits feature advanced RF techniques, including automatic PIN-diode attenuators that bring a number of user benefits:

- Automatic triggering
- Excellent overload protection; 12 Vrms
- High AM tolerance: up to 98%
- Wide dynamic range: 10 mV rms...12 Vrms

For high-speed/high-accuracy measurements, the "extra powerful" 600 MHz model PM 6675 offers direct gating (non-prescaled) and a high 5 mVrms sensitivity.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 6673, PM 6674, PM 6675 & PM 6676

RFI Suppression

Effective precautions have been taken to reduce radiation and susceptibility to radio frequency interference (RFI) to minimum levels. For example, all the counters are encased in sturdy metal cabinets, which provide excellent RFI shielding. Reduction of RFI radiation far below the most severe requirements, including VDE 0871 (B) and MIL STD 461, contributes to the superior accuracy of these models.

Variable Measuring Time

Another microcomputer benefit is the continuously variable measuring time, which is no longer limited to decade steps. It is possible, for example, to select a measuring time of 2.4 seconds if one second does not give sufficient resolution. This avoids the need to switch directly to a time-wasting 10 second measurement period.

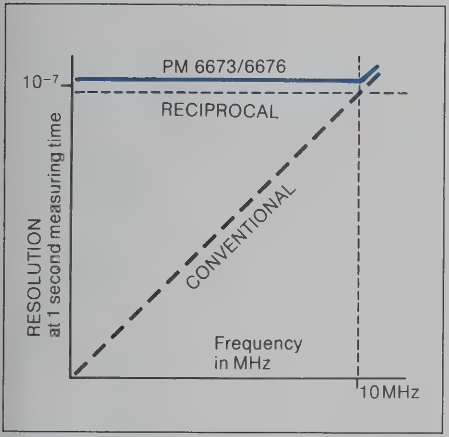


Fig. 1. The PM 6670 series benefits from both RECIPROCAL and CONVENTIONAL measuring principles. Automatic selection of the measuring mode always gives the best possibel resolution.

Choice of Time Base Oscillator

The time base crystal oscillator determines the accuracy limit of the counters.

Note that even the most stable version (5×10^{-10}/24h) can be operated from internal batteries. This unique feature is achieved by specially developed oven-stabilized crystal oscillators with extremely low power consumption. Thus laboratory accuracy is now available for field applications—without irritatingly long warm-up times after changing location.

By means of the external reference input, the user's own frequency standard can be used, when available.

Frequency Average

The use of microcomputers provides new opportunities in frequency measurements. The computing measuring principle, with sychronized sample-taking, enables frequency and period measurements to be made during one or a great number of measuring intervals. Start and duration of these intervals are controllable via an external gate input.

Individual samples may be as short as 500 ns or as long as 96 seconds.

Multiple-burst-frequency measurements or sampling frequency-sweep-profiles can be activated by a single control.

Specifications

Measuring Modes

Frequency

Range

Sine: 10 Hz...120 MHz (PM 6673)
10 Hz...550 MHz (PM 6674)
10 Hz...600 MHz (PM 6675)
10 Hz... 1.5 GHz (PM 6676)
Pulse: Minimum frequency down to 0.1 Hz

Mode: RECIPROCAL and CONVENTIONAL. For the highest possible resolution for both LF and HF measurements, the counter employs the RECIPROCAL mode for LF signals. Above 10 MHz it automatically uses the CONVENTIONAL mode.

For special applications, one can select either RECIPROCAL or CONVENTIONAL.

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST FREQUENCY AVERAGE. In the FREQUENCY AVERAGE mode (rear panel selectable), the counter measures the average of a multiple of frequency samples. Samples are taken with external gate control (≥500 ns) and totalized during the selected measuring time (10 ms...96s) to allow multiple burst frequency measurements or to sample frequency sweep profiles.

LSD Displayed: 10^{-8} Hz...10^{2} Hz (PM 6673 and PM 6675), 10^{-8} Hz...10^{3} Hz (PM 6674 and PM 6676), depending on measuring time and input frequency. At least 7 digits displayed per second of measuring time.

Resolution: LSD*

Inaccuracy (rel. error):

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \text{rel. trigger* error}$$

± time base error

Period Average

Range: 100 ns...100s

LSD Displayed: 10^{-16}...10^{-6}s, depending on measuring time and period duration. At least 7 digits displayed per second of measuring time.

Resolution: LSD*

Inaccuracy (rel. error):

$$\pm\frac{\text{resolution}}{\text{PERIOD}} \pm \text{rel. trigger* error}$$

± time base error

Ratio

Range:

$$\frac{\text{FREQ A}}{\text{FREQ D}} = \frac{\text{10 Hz...120 MHz}}{\text{1 kHz...10 MHz}}\ \text{(PM 6673)}$$

$$\frac{\text{FREQ A or B}}{\text{FREQ D}} = \frac{\text{10 Hz...550 MHz}}{\text{1 kHz...10 MHz}}\ \text{(PM 6674)}$$

$$\frac{\text{FREQ A or B}}{\text{FREQ D}} = \frac{\text{10 Hz...600 MHz}}{\text{1 kHz...10 MHz}}\ \text{(PM 6675)}$$

$$\frac{\text{FREQ A or B}}{\text{FREQ D}} = \frac{\text{10 Hz...1.5 GHz}}{\text{1 kHz...10 MHz}}\ \text{(PM 6676)}$$

LSD Displayed:
10^{-8}...10^{-1} (A/D all models and B/D; PM 6675)
10^{-8}...10^{0} (B/D; PM 6674)
10^{-8}...10^{0} (B/D; PM 6676); depending on measuring time and ratio

Resolution: LSD*

Inaccuracy (rel. error):

$$\pm\frac{\text{resolution}}{\text{RATIO}} \pm \text{rel. trigger* error D}$$

Count

Totalize Range: 1...10^{17}, with indication of k-pulses, M-pulses and G-pulses beyond the 10^{9} display range

Frequency Range:
Sine: 10 Hz...10 MHz
Pulses: 0 Hz...10 MHz
Sequential start-stop periods are accumulated or individually totalized after reset.

Auxiliary Functions

Measuring Time

The measuring time is "continuously" variable (33 steps/decade): 10 ms...96s, with clear set-points at 10 ms, 100 ms, 1s, 10s and 96s. Selected measuring time is displayed, without any delay, when depressing the measuring time control.

On/Stand By

In "ST BY" position, power is available to maintain an ovenized crystal oscillator heated and to recharge the optional battery pack.

Check

10 MHz internal reference connected to logic circuitry. Self-test of most measuring functions can be selected. By using this mode, the COUNT function provides a stop-watch facility.

Display Hold

Depressing "DISP HOLD" button sets display time to infinite and freezes the last measurement result. A new measurement can be initiated using reset.

In the COUNT mode, the "DISP HOLD" control is used to start and stop manual totalizing.

** See definitions*

PM 6673, PM 6674, PM 6675 & PM 6676

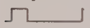
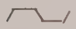
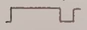
Reset

Manual via push button or electrical via input E.

Input and Output Specifications

LF-Input (Channel A)

Frequency Range: 10 Hz...120 MHz
Sensitivity:
Sine: 10 mVrms (20 Hz...120 MHz), 6 dB down at 10 Hz
Pulse: 30 mV_{pp} (0 Hz...120 MHz), minimum pulse duration 4 ns
Attenuation: Continuously variable in two ranges between x 1...x 500. Noise immunity band (hysteresis band) can be continuously adjusted over the range: 20 mV_{pp}... 10 V_{pp} nominal.
Noise Filter: Switchable 50 kHz Low Pass filter. Noise suppression ≥20dB at 500 kHz
Impedance: 1 MΩ//≤25 pF
Trigger Level: Switchable with waveform selectors for optimum triggering on signals of various duty factors.

 : for duty factor of <0.25
 : for duty factor of 0.25...0.75
 : for duty factor of >0.75

Coupling: AC
Maximum Voltage Without Damage:
DC: 300V
AC: 260 Vrms at 1440 Hz declining to 12 Vrms at ≥1 MHz (in 10 mVrms range), 260 Vrms (in 200 mVrms range)

RF-Input (Channel B)

Frequency Range:
PM 6674: 50 MHz...550 MHz; 6 x prescaled
PM 6675: 50 MHz...600 MHz; direct gating
PM 6676: 100 MHz...1.5 GHz; 16 x prescaled
Operating Input Voltage Range:
10 mVrms ...12 Vrms
PM 6675: Sensitivity is 5 mVrms (100 MHz ... 500 MHz)
PM 6676: sensitivity above 1 GHz decreases to 30 mVrms (worst-case) or 15 mVrms (typical) at 1.5 GHz.
Impedance: 50Ω nominal; VSWR <2
Coupling: AC
AM Tolerance: 98%; minimum signal must exceed 30 $mV_{p\text{-}p}$
Maximum Voltage Without Damage: 12V; overload protection with PIN diodes

Ext. Reference and Ratio Input (Ch. D)

Frequency Range: 1 kHz...10 MHz
Sensitivity: 500 mVrms
Impedance: Approx. 2 kΩ
Coupling: AC
Max. Voltage Without Damage: 25 Vrms

Note: As external reference frequency, only 10 MHz will give correct decimal point and unit indication. With the optional frequency multiplier PM 9697 references of 1 and 5 MHz can also be accepted.

Ext. ARMING/FREQ-AVG/RESET (Ch. E)

A 3-position rear panel switch gives choice of external control over:

ARMING: In this position the counter is prevented from starting a new measurement when input E is high. A high-to-low going pulse arms the counter to start a new measurement.

Note: Arming not applicable in COUNT mode.

FREQUENCY A AVERAGE: When making reciprocal frequency or period measurements, the measurement is interrupted when input E is high. The measurement is continued again when input E is low.
To allow frequency average measurements up to 100 MHz, the automatic switching to the CONVENTIONAL mode above 10 MHz is omitted.
The effective measurement time (defining resolution and accuracy) is the sum of external gate times that occurs during the selected measurement time.
EXT. RESET-START: Electrical reset, equivalent to the front panel RESET push button. (See HOLD and RESET). Counter is reset when input E goes high. A new measurement can be made after input E has returned low.
Input Levels: *High:* ≥2V; *Low:* ≤0.5V
Input Impedance: Approx. 2 kΩ
Max. Input Voltage Without Damage: ±25V
Minimum Pulse Duration:
Arming and Frequency Avg: 500 ns
External Reset: 200 µs

Time-Base Oscillator Output

Crystal Frequency: 10 MHz
Output Level: LS-TTL compatible
Output Impedance: Approx. 4008
Coupling: DC
Overload Protection: Short-circuit proof

General Specifications

Time Base

For specifications, see table on page 358.

Display

Readout: 9 digits, 11 mm high-efficiency LEDs. Microprocessor control of display format, decimal point and unit indication: Hz, kHz, MHz, GHz, ns µs, ms and s.
Display Time: Continuously variable 80 ms... 96s plus DISP HOLD.
Gate Lamp: Indicates that main-gate is opened and measurement takes place.
ST BY: Stand-by indication with LED when instrument is not switched ON.
REMOTE: Indicates when control over counter is taken by the installed bus interface option (IEEE-488).
Low-Battery: Indication by blinking display some 15 min. before recharging is needed.

Power Requirements

These counters can be powered from: line voltage,and optional battery or external battery voltage.

Line: 115/230V ±15%; 45...440 Hz; <25 VA
Internal Battery Unit: PM 9693
External DC Source: 11.8V...28V
Line Interference: Below VDE 0871 (B) and MIL STD 461
Safety: According to IEC 348 and CSA 556 B

Dimensions and Weight

Dimensions: 210 mm W x 89 mm H x 280 mm L (8.25 in W x 3.8 in H x 11 in L)
Weight: 2.5 kg (5.5 lb)

Environmental Conditions

Temperature:
Rated Range of Use: -5°C...+50°C
Functional Operation: -10°C...+55°C
Storage and Transport: -40°C...+70°C
Humidity:
Operating: 10...90% RH, no condensation.
Storage: 5...95% RH.
Altitude/Barometric Pressure:
Operating: 5000m (15000 ft) -53.3 kN/m²
Storage: 15000m (50000 ft) -15.2 kSN/m²

Definitions

LSD Displayed:

Unit value of Least Significant Digit displayed
For Frequency <10 MHz or Period Average:

$$\text{LSD} = \frac{2.5}{\text{measuring time}} \times \frac{\text{FREQ or PERIOD}}{10^7\ \text{Hz}}$$

For Frequency >10 MHz:

$$\text{LSD} = \frac{2.5 \times \text{prescaling factor}^{(p)}}{\text{measuring time}}$$

For Ratio:

$$\text{LSD} = \frac{2.5 \times \text{prescaling factor}^{(p)} \times \text{RATIO}}{\text{measuring time} \times \text{FREQ A or B}}$$

Resolution:

Smallest increment between two measuring results, being most often 1 LSD unit. Due to arithmetic truncation the resolution can be 2 LSD units, but can then be reduced to 1 LSD unit, by doubling the measuring time.

The Resolution is 2 LSD Units:

$$\text{if: LSD} < \frac{1}{\text{measuring time}} \quad \text{(Freq. >10 MHz)}$$

$$\text{or if} \quad \frac{\text{LSD x measuring time}}{\text{FREQ or PERIOD or RATIO}} < 10^{-7}\text{s}$$

(Freq. ≤10 MHz, Period or Ratio).

In all other cases the resolution is 1 LSD unit. All calculated LSD's shall be rounded to nearest decade (e.g. 5 ns will be 10 ns and 0.4 Hz will be 0.1 Hz) and cannot exceed the 9th digit.

Resolution:

Smallest increment between two measuring results, being most often 1 LSD unit. Due to arithmetic truncation the resolution can be 2 LSD units, but can then be reduced to 1 LSD unit, by doubling the measuring time.

Rel. Trigger Error

For any Waveform:

$$\frac{\text{peak-to-peak noise voltage}}{\text{signal slope (V/s)} \times \text{measuring time}}$$

For Sinewave:

$$\frac{1}{\text{FREQ} \times \text{measuring time} \times \pi \times \text{S/N ratio}}$$

Example: For S/N ratio of 100 (40 dB) and 1 second measuring time, the trigger error is:

$$\frac{3 \times 10^{-4}}{\text{FREQ}}$$

IEEE-488 Interface Data

IEEE Interface Option PM 9696: Can be supplied fitted (to order), or retrofitted in the field.
Connector: 24-pole: address set by switches
Output Data: Measuring data including function code, overflow and range. Status data, generated at serial poll or after instruction, including full programming status data and function status
Output Rate: 10...20 readings per second
Input Data: Programing data for all manually controllable functions except input trigger functions

Included with the instrument: Operating manual, line cord

Ordering Information

Models

January 1989 prices

PM 6670 120 MHz timer/counter, 100 ns single shot resolution, standard oscillator 5 x 10^{-7}/month	$1075
PM 6671 As PM 6670 but with extended facilities	1195
PM 6672 As PM 6670 but with extended facilities and frequency range to 1GHz	1495
PM 6673 120 MHz counter, standard oscillator 5 x 10^{-7}/month	975
PM 6674 As PM 6673 but with frequency range to 550 MHz	$1250
PM 6675 As PM 6673 but with frequency range to 600 MHz (direct gated)	1395
PM 6676 As PM 6673 but with frequency range to 1.5 GHz	1395

Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit /suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface

Input Frequency Option:

/0-- 120 MHz for PM 6670, 6671, 6673	N/C
/1-- 600 MHz (direct gated) for PM 6675 only	N/C
/3-- 550 MHz for PM 6674 only	N/C
/4-- 1 GHz for PM 6672 only	N/C
/5-- 1.5 GHz for PM 6676 only	N/C

Reference Oscillator Option:

/-1- Standard	N/C
/-2- TCXO (PM 9678B/01)	add 225
/-3- Ovenized Crystal Oscillator (PM 9679E/01)	add 450
/-4- Very High Stability Crystal Oscillator (PM 9690/01)	add 645
/-5- Ultra High Stability Crystal Oscillator (PM 9691/01)	add 845
/-8- Externally Referenced Frequency Multiplier (PM 9697/00), with Standard Oscillator only	add 175

Interface Option:

/--1 Standard, non GPIB IEEE-488	N/C
/--3 Battery (PM 9693/00) for all except PM 6670	add 250
/--4 BCD Output & Display Offset (PM 9694/00) for all except PM 6670	add 325
/--5 Analog Output (PM 9695/00) for all except PM 6670	add 405
/--6 GPIB IEEE-488 (PM 9696B/00) for all except PM 6670	add 300

Example, Ordering Configuration:

To order the PM 6671 with standard 120 MHz input, temperature compensated oscillator, & no interface, select:

		Model	Price
		PM 6671	$1195
Configuration			
Option Suffix -	Input	/0--	N/C
	Oscillator	/-2-	225
	Interface	/--1	N/C
Yields Complete Model Number		PM 6671/021	1420

Options and Accessories

PM 9669/01 19-in Rackmount Adapter to fit one instrument	$75
PM 9669/02 19-in Rackmount Adapter to fit two instruments	110
PM 9672/70 Carrying Case	70
PM 9678B/01 Temp. Compensated Oscillator	225
PM 9679E/01 Ovenized Crystal Oscillator	450
PM 9690/01 Very High Stability Oscillator	645
PM 9691/01 Ultra High Stability Oscillator	845
PM 9693/00 Battery Unit	250
PM 9694/00 BCD Output and Display Offset Unit	325
PM 9695/00 Analog Recorder Output	405
PM 9696B/00 IEEE-488 Bus Interface	300
PM 9697/00 External Reference Frequency Multiplier	175
PM 9581/01 50Ω Feed-Through Termination 3W	65
PM 9585/01 50Ω Feed-Through Termination 1W	30

Note: PM 6670 cannot be equipped with options PM 9693, PM 9694, PM 9695 and PM 9696.
PM 6671...PM 6676 can be equipped with max. one of these options.
The PM 9697 multiplier can only be installed simultaneously with the /01 oscillator. For installation in other versions the oscillator has to be removed first.

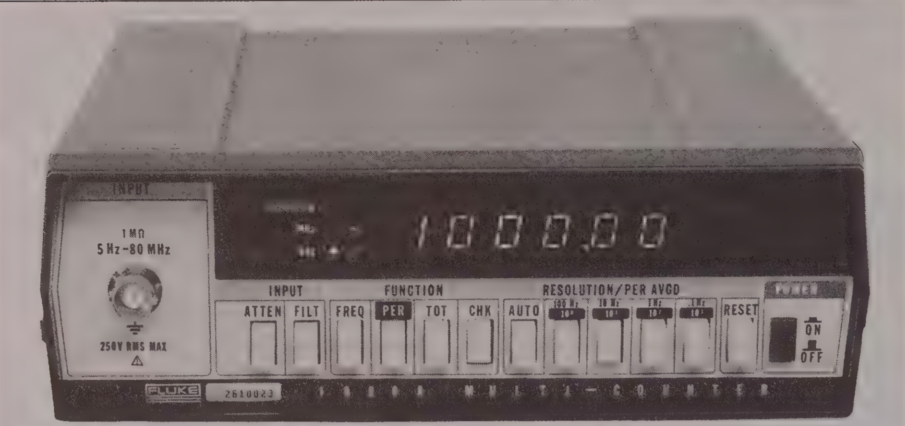
Service & Support

Warranty

One-year product warranty. See Page 470 for further information on warranty terms and conditions.

The above configurations meet North American power requirements. For other power options, see page 491.

1900A



(NSN 6625-01-049-1844) **1900A**

1900A Multifunction Counter

- Frequency, period, period averaging and totalize measurements
- 6-digit display
- 1 MHz low-pass filter
- Available with full parallel BCD output and rechargeable battery

Fluke's versatile 1900A Multi-Counter provides frequency, period, period averaging, and totalize measurements over a wide range of applications. In frequency mode, the 1900A verifies the accuracy of signal sources such as generators, oscillators and transmitters. Period mode measures the time duration of a single input cycle, which allows high resolution of low frequency measurements. In period average mode, the counter averages cycle time over 10, 100 or 1000 cycles for still finer resolution. Totalize mode is similar to frequency mode except that the signal gate is open and closed deliberately, a feature useful for totalizing the cycles in a single RF burst or counting electromechanical relay contact bounce. A selectable 1 MHz low-pass filter provides input signal conditioning to give accurate low frequency measurements in electrically noisy environments. A selectable 10:1 attenuator is provided.

A rechargeable battery is included in Model 1900A-01, providing up to 4 hours of operation with a 14 hour recharge time.

Specifications

Technical Specifications

Frequency: 5 Hz to 80 MHz. Four manually-selected gate times of 10 ms (100 Hz resolution), 100 ms (10 Hz resolution), 1s (1 Hz resolution), and 10s (0.1 Hz resolution). Autorange position automatically seeks to fill all 6 digits but will not select a gate time greater than 1s (1 Hz resolution)

Period: 5 Hz to 1 MHz. Manual selection of single period or 3 period-averaging ratios:

10^0 single period (100 ns resolution)
10^1 periods averaged (10 ns resolution)
10^2 periods averaged (1 ns resolution)
10^3 periods averaged (100 ps resolution)

Autorange position automatically seeks to fill all 6 digits but will not select a period average of greater than 10^2 averages

Totalizing: Accumulates up to 999999 counts, then activates overflow indicator

Sensitivity: 25 mV, typically 15 mV rms sine wave, 5 Hz to 80 MHz. Frequency and totalize: 200 mV peak-to-peak pulse amplitude with minimum pulse width of 20 ns. Duty cycle <10%. Period: 200 mV peak-to-peak pulse amplitude with minimum pulse width of 200 ns. Duty cycle <10%

Input Impedance: 1 MΩ, ≤30 pF

Noise Filter: 1 MHz (3 dB point) lowpass

Attenuator: Decreases sensitivity by 10

Overload: 250V rms 5 Hz to 1 kHz decreasing to 20V at 80 MHz

Timebase

Frequency:	10.00 MHz
Aging Rate:	$<\pm 5 \times 10^{-7}$/mo
Temperature Accuracy:	
0°C to 50°C	$<\pm 5 \times 10^{-6}$
Line Variation: (±10%)	$<\pm 1 \times 10^{-7}$

Display: 6-digit LED, leading zero suppression. Time between successive measurements is 200 ms plus measurement time.

Annunciation: MHz, kHz, ms, µs, overflow

Autorange: In both frequency and period modes, autoranging includes a unique 20% hysteresis in its switching thresholds to eliminate redundant up-range/down-range commands. This allows measurements to be made on signals containing large amounts of FM and øM. Hysteresis memory can be reset by depressing the "Reset" button

General Specifications

Autoreset: A new measurement sequence is started every time a front panel button is activated

Temperature: 0°C to +50°C operating (40°C max in battery version if being charged while operating); -40°C to +60°C, non-operating

Power: 115 or 230V ac ±10% (100V ac available) 50, 60 or 400 Hz. 6.5W line model, 8.5W battery model

Fuses: 1/8A line version, 1/2 amp slow-blow battery version

Size: 6 cm H x 22 cm W x 25 cm D (2.5 in H x 8.5 in W (including handle) x 10 in D)

Weight: 1.2 kg (2.75 lb), 1.9 kg (4 lb) with batteries

Included: Instruction manual, power cord. Order Y9111, Y9112 coaxial cable(s) and Y9103 50Ω Terminator separately

Ordering Information

Models

January 1989 prices

1900A Multifunction Counter	$510
1900A-01 w/Rechargeable Battery	695

Accessories (Also see page 485)

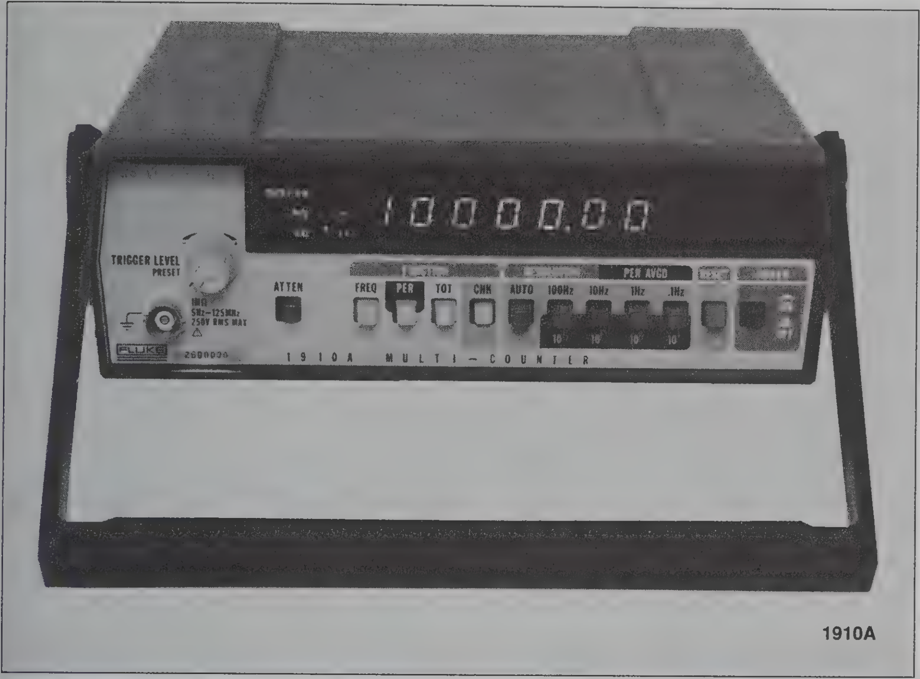
A53 Whip Antenna	30
C86 Carrying Case, Molded Plastic	20
Y7201 Attenuator/Filter	65
Y8205 Soft Carrying Case w/shoulder strap	35
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω	20
Y9112 6 ft (1.85m) Coaxial Cable, 50Ω	20
Y9103 50Ω Feed-thru Terminator	35
M00-100-714 Dust Cover	10
M00-200-611 3" Rack Adapter, Offset	50
M00-200-612 3" Rack Adapter, Center	50
M00-200-613 3" Rack Adapter, Dual	60

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

1910A, 1911A & 1912A



1910A

1910A, 1911A & 1912A Multifunction Counters
Frequency, period, period averaging and totalize measurements
7-digit display
Autoranging
Autoreset
Instant warning when input signal falls below sensitivity threshold
(Models 1911A and 1912A)
Rechargeable battery pack version

These rugged counters are at home on the production line, in the lab, or in the field and do the work of counters costing much more. They measure frequencies to 125 MHz, 250 MHz or 520 MHz (depending on model), period of signals to 2 MHz, period average to 10 ps resolution and totalize to 9,999,999 counts.

Autorange

Full autoranging is supplemented by select able four-range manual operation. In autorange, the display is automatically filled to a maximum 7-digit readout. A unique hysteresis capability eliminates undesirable up-and-down ranging for between-range signals.

Autoreset

This automatic feature is activated every time you select a new range or function, which means you never have to wait for a second reading, the first one in the new measurement sequence is always correct. Autoreset saves time and reduces errors.

Automatic Clean Dropout

The 1911A and 1912A Channel B input has a circuit which automatically monitors the input and gives you instant warning in the form of zero readout whenever your input signal falls below the sensitivity threshold of the trigger circuit. When the signal level returns to an acceptable level, the counter locks on for a correct reading.

Sensitivity

A basic sensitivity of 15 mV, backed by Fluke's conservative design margin, guarantees you will get reliable, solid readings every time. In practice, a typical sensitivity of 10 mV will be experienced.

Versatile Timebases

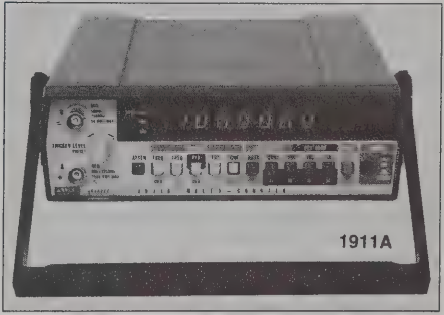
The standard 0.5 ppm per month timebase assures excellent long term stability for bench, production or field use. A convenient rear panel external timebase input jack and switch let you operate from your own 10 MHz frequency standard at any time. Choice of optional time bases with improved aging rates and temperature stabilities allows you to purchase only as much stability as you'll need in your applications.

Input Signal Conditioning

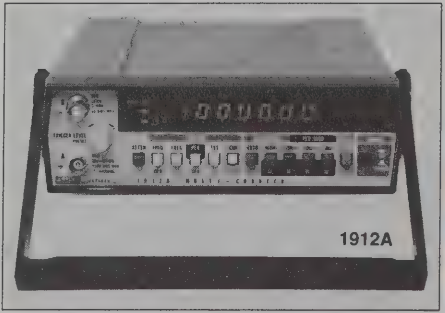
Each counter offers trigger level and attenuator controls which operate over the dynamic range of the input to permit accurate readings in the presence of noise. Even ringing TTL signals can be accurately measured. In addition, the 1911A offers a separate 50 ohm input for 50 MHz to 250 MHz and the 1912A does the same but goes to 520 MHz.

Battery Portability

All three counters are available with recharge able batteries for field portability. Order 1910A - 01, 1911A-01, or 1912-01. Four hours minimum operation gives you plenty of opportunity to solve those tough field service problems.



1911A



1912A

1910A, 1911A & 1912A

Specifications

Model	Channel	Operating Range		Sensitivity	Input Impedance	Overload (Max Input Voltage)	Prescale Factor
		Frequency	Period				
1910A	A	5 Hz-125 MHz	500 ns-0.2s (5 Hz-2 MHz)	15 mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 MΩ/30 pF, ac coupled	dc + ac; <360V pk; 250V rms, 5 Hz - 1 kHz 10V rms above 1 kHz	–
1911A	A	5Hz 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 mΩ/30 pF ac coupled	dc + ac;<360V pk; 250V rms, 5 Hz - 1kHz 10V rms above 1 kHz	–
	B	50 MHz- 250 MHz	–	15 mV rms, 50 MHz - 175 MHz 30 mV rms, 175 MHz - 250 Mhz	50Ω, VSWR <2.5:1	dc + ac: <100V pk; 5V rms, fuse protected	2
1912A	A	5 Hz - 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 MΩ/30 pF ac coupled	dc + ac; <360 V pk; 250V rms, 5 Hz - 1 kHz 10V rms above 1 kHz	–
	B	50 MHz- 520 MHz	–	25 mV rms, 50 MHz - 520 MHz	50Ω, VSWR <2.5:1	dc +ac: <100V pk; 5V rms, fuse protected	4

Specifications

Technical Specifications

Ch. A Attenuator: X1, X10 (approx.)
Ch. A Trigger Level: ±0.5V range
Ch. A Totalize: 1 to 9,999,999 counts
Frequency Accuracy: Timebase accuracy ±1 count
Period Accuracy: Frequency accuracy plus trigger error*

** Trigger error is less than 0.3% of one period ÷ periods averaged for sinewaves of 40 dB signal-to-noise ratio or better and amplitude equal to sensitivity of counter*

Frequency Resolution: 0.1 Hz, 1 Hz, 10 Hz, 100 Hz, manually selected. Autorange automatically seeks to fill 7 digits but will not select gate time <1 second
Period Resolution: 100 ns, 100 single period; 10 ns, 101 period averaged; 1 ns, 102 periods averaged; 100 ps, 103 periods averaged. Autorange automatically seeks to fill 7 digits; if input frequency is high enough, may select 104 periods averaged (10 ps resolution) but will not select measurement time <1 second

Option Specifications

TCXO Options (-03, -04)

Timebase Selection Guide

Type (10 MHz)	Aging Rate	Line Variation (±10%)	Temperature Accuracy 0-50°C
Standard	$\pm 5 \times 10^{-7}$/mo	$\pm 1 \times 10^{-7}$	$\pm 5 \times 10^{-6*}$
Option -03	$\pm 3 \times 10^{-7}$/mo	$\pm 2 \times 10^{-8}$	$\pm 2 \times 10^{-6*}$
Option -04	$\pm 3 \times 10^{-7}$/mo	$\pm 2 \times 10^{-8}$	$\pm 5 \times 10^{-7*}$

**p-p variation*

General Specifications

Display: 7-digit LED, leading zeros suppressed
Annunciation: MHz, kHz, msec, +sec, overflow
Operating Temperature: 0°C to 50°C (line models). 0°C to 40°C (battery models) when operating and charging
Storage Temperature: -40°C to +70°C (line models), -40°C to +60°C (battery models)
External Timebase Input
Frequency: 10 MHz to 300 kHz (typical)
Amplitude: 300 mV rms, 5V p-p max
Input Impedance: <1 kΩ
Power, Line Models: 100, 115, or 230V ac ±10%, 48 Hz to 440 Hz, 8W maximum
Power, Battery Models
100V ±10%, 48 Hz to 52 Hz, 8.5W max
100V ±10%, 58 Hz to 62 Hz, 8.5W max
115V ±10%, 58 Hz to 62 Hz, 8.5W max
230V ±10%, 48 Hz to 52 Hz, 8.5W max

Note: Voltage and frequency must be specified at time of order

Time (between successive measurements): 200 ms plus measurement time
Size: 6.4 cm H x 21.7 cm W x 27.1 cm D (2.52 in H x 8.55 in W x 10.65 in D)
Weight: 1.5 kg (3.2 lb) max, for line models. 2.2 kgm (4.8 lb) max for battery models
Safety: Factory Mutual 3820 approved, CSA 556B certified
Included: Instruction manual, power cord. Order Y9111 or Y9112 coaxial cable(s) and Y9103 50-Ohm Terminator separately

Y7201 Attenuator/Filter

The Y7201 is a combination variable attenuator and selectable low pass filter which can be used for input signal conditioning on all counters. Typical specifications are:
Input Impedance: 47 kΩ
Attenuation Range: X5 to X100, continuously adjustable
Low Pass Filter: 1 kHz, 20 kHz or 100 kHz, switch-selectable
Maximum Input: 30V ac

Ordering Information

Models

January 1989 prices

1910A 125 MHz Multifunction Counter	$685
1910A-01 W/Rechargeable Battery	845
1911A 250 MHz Multifunction Counter	840
1911A-01 W/Rechargeable Battery	975
1912A 520 MHz Multifunction Counter	925
1912A-01 W/Rechargeable Battery	1050

Specify line voltage and frequency if other than 60 Hz and 115V ac

Options (for 1910A, 1911A & 1912A)

19XXA-03* 2 ppm TCXO	245
19XXA-04* 0.5 ppm TCXO	305

**Factory installation only.*

Accessories (Also see page 485)

A53 Whip Antenna	30
Y7201 Attenuator/Low Pass Filter	65
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω BNC to BNC	20
Y9103 508 BNC Feed-thru Terminator	35
C86 Carrying Case, Molded Plastic	20
Y8205 Soft Carrying Case w/shoulder strap	35
M00-200-611 3" Rack Adapter, Offset	50
M00-200-612 3" Rack Adapter, Center	50
M00-200-613 3" Rack Adapter, Dual	60

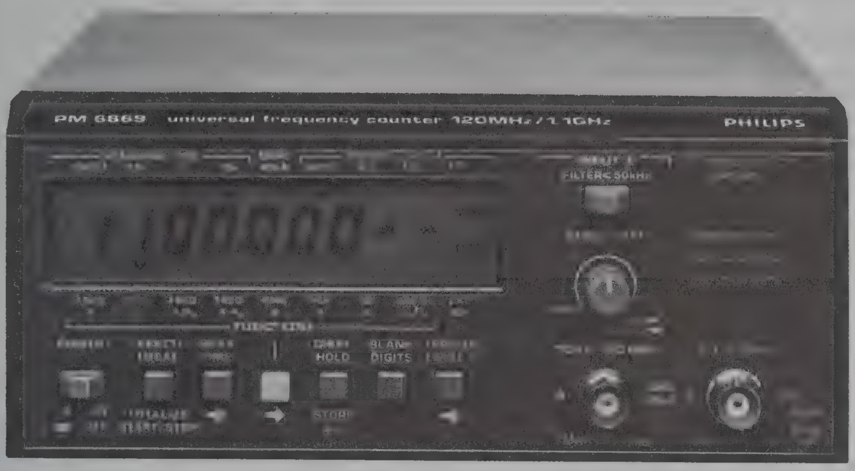
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

PM 6669

GPIB
IEEE-488



PM 6669

PM 6669 Multifunction High-Resolution Frequency Counter
Unrivalled price/performance
High resolution reciprocal counting
Error-free triggering
High stability MTCXO; 2x10^{-7} over 0°..50°C with pushbutton calibration
Eight measuring modes including PULSE WIDTH
Versatile use with the GPIB interface or battery operation
1.3 GHz RF-input

Introduction

The PM 6669 is a multi-function frequency counter, spanning the frequency range from 0.1 Hz...120 MHz, or optionally up to 1.3 GHz. Measuring functions include FREQUENCY, frequency deviation FREQ A-A$_0$, FREQ A/A$_0$, RPM, PERIOD, TOTALIZE counts and PULSE WIDTH.

The built-in microprocessor uses the reciprocal frequency-counting technique to yield high resolution measuring results under all conditions even on low frequency measurements.

Measuring accuracy is enhanced by the high-performance front-end, providing contin uous adjustment of sensitivity and noise immunity. Accuracy can be further increased with the optional high stability time-base.

The instrument is designed to fulfill a broad range of needs with a full range of options, including a GPIB bus interface for systems use and a battery pack for line independent field use.

High Stability MTCXO

Until now, choice of the crystal timebase oscillator, which determines the final accuracy of the counter, was only between the low-cost uncompensated standard crystal oscillators, medium price TCXOs (temperature compensated crystal oscillators) and high price, high stability oven-controlled oscillators.

Now, Philips has developed a mathematically compensated crystal oscillator which costs the same as a normal TCXO yet has a stability of 2 x 10^{-7} (0...50°C), fully comparable with an oven stabilized oscillator.

This new oscillator is called the MTCXO or Mathematically Temperature-Compensated Crystal Oscillator. It has an associated non-volatile memory, in which are stored the frequency deviations from the factory measured temperature dependent frequency curve at each temperature. During a measurement, the temperature of the crystal is measured, the deviation for that temperature is retrieved from the memory and the result is automatically compensated before display. In addition, because the temperature of the crystal is always compensated for each measurement, no warm up time is required for high accuracy measurement.

If ultra-high stability calibrations are needed, the PM 6669 is provided with an input for an external reference frequency source.

Unprecedented Counter Value

The precision and stability of the MTCXO oscillator isn't the only way that PM 6669 sets new standards. A durable and stable metal cabinet that provides excellent RFI shielding; a big benefit over the cheaper plastic cabinets found in many other instruments.

PM 6669 also has high-sensitivity input circuitry, with automatic triggering on all input waveforms, continuously variable attenuation and a switchable low-pass filter for noise reduction all features normally found only in higher-priced counters.

PM 6669 also offers an optional GPIB/IEEE-488* bus interface that provides full remote programmability of all major functions, making it probably today's lowest cost programmable precision counter.

And finally, PM 6669 uses Philips' state-of-the-art electronics technology throughout, including a new LSI single-chip counter which, together with a single-chip microprocessor, forms the complete counter logic. SMD (surface-mounted device) technology is also used for precise, highly automated assembly.

Our advanced technology results in compact construction, low dissipation and very high reliability. All these benefits, in combination with PM 6669's very attractive price level, add up to an unprecedented combination of counter performance and value.

High-Resolution Measurements

Synchronized multiple-period measurements, with computation of the reciprocal value, allow high-resolution measurements on signals of all frequencies. PM 6669's microprocessor eliminates traditional ±1 input cycle errors, resulting in a measurement result of at least 7 digits per second of measuring time, regardless of the input frequency. This capability eliminates the need for the long gate times or period measurements which are normally required to obtain high resolution.

A full 9-digit display allows complete presentation of the measurement result, while unstable or insignificant display digits can be blanked to avoid erroneous readings of the display.

Measuring accuracy is further assured by front-end circuitry that gives error-free triggering for all input waveforms. The low-pass filter effectively

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** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 6669

suppresses spikes, noise and interference, and even rejects spurious HF components that are stronger than the input signal itself. In addition, the wideband, continuously variable attenuator allows optimum matching of trigger sensitivity and noise immunity over a wide dynamic range from 20 mV p-p to 10V p-p.

Frequency Range up to 1.3 GHz

The standard PM 6669 has a measuring range that extends from 0.1 Hz up to 120 MHz. Optionally available is a high-frequency input that extends the input up to 1.3 GHz, for example for telecommunications applications. This input can handle voltages from 10 mV rms up to 12V rms for maximum versatility in operation.

The Versatile Counter

PM 6669's wide frequency bandwidth and high-precision performance make it the ideal counter for a very wide range of measuring applications: on the test bench, telecommunications and general purpose lab environments, in IEEE-488 bus systems and with the optional battery pack, in the field.

A selection of special purpose options can all be user-retrofitted as and when needed. This choice allows exactly the right instrument configuration to be selected for each application, without the need to buy unnecessary features. These options include high-stability timebase, 1.3 GHz input, GPIB (IEEE-bus) interface, rack mount assembly, carrying case and battery pack.

Specifications

Measuring Functions

Frequency A or B

Range:
Freq A: 0.1 Hz...120 MHz. Typically...160 MHz
Freq B: 70 MHz...1.3 GHz (optional)
Mode: Reciprocal frequency counting

$$\text{LSD displayed} \quad \frac{2.5 \times 10^{-7} \times \text{frequency}}{\text{measuring time}}$$

Frequency A/A$_0$

A Frequency A measurement is done. The measured frequency is divided by the constant A_0 before display. A_0 is read from channel A and is stored using the STORE A_0 button. The resolution of the displayed ratio is determined by the Frequency A measurement. At power-on A_0 is set to 1 (default).

Frequency A-A$_0$

A Frequency A measurement is done. The value of constant A_0 is subtracted from the measured frequency before display. A_0 is read from channel A and is stored using the STORE A_0 button. The resolution of the displayed difference is determined by the Frequency A measurement. At power-on A_0 is set to 0 (default).

RPM A

A Frequency A measurement is done. The measured frequency is multiplied by 60, and shown on the display as revolutions per minute (rpm).
Range: 0.1 Hz...12 MHz (6 rpm...720 x 10^6 rpm)

Period A

Range: 8 ns...2x10^8s. For sinewave signals, period must not exceed 0.1s
Mode: Single period measurement (SINGLE) and average period measurement (at 0.2, 1 and 10s meas times).
LSD Displayed
Single period measurement: 100 ns (Time <100s)
Period average measurement:

$$\text{Period average measurement:} \quad \frac{2.5 \times 10^{-7}\ \text{period}}{\text{measuring time}}$$

Totalize A

The event counting is controlled by the Start/Stop button. Sequential start-stop counts are accumulated. Reset closes the gate and resets the counter to zero.
Range: 0...1 x 10^{15} with indication of K or M (Kilopulses or Mega-pulses). The result is truncated if out of display range
Frequency Range:
Sine: 10 Hz...12 MHz;
Pulse: 0 Hz...12 MHz

Width A

A positive Pulse Width measurement on a repetitive signal is done.
Range: 100 ns...2 x 10^8s
LSD Displayed: 100 ns (Width <100s)

Definitions

LSD Displayed

Unit value of the least significant digit displayed. All calculated LSDs (see measuring functions section) should be rounded to the nearest decade (e.g. 0.3 Hz is rounded to 0.1 Hz and 5 Hz to 10 Hz) and cannot exceed the 9th digit.

Resolution

Smallest increment between two measuring results on the display, due to the ±1 count error.
Freq A, B, Period A: Resolution can be 1 LSD unit or 2 LSD units. If

$$\frac{\text{LSD measuring time}}{\text{FREQ or PERIOD}} < 10^{-7}$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability)

SINGLE: Period A and Width: Resolution equals 1 LSD unit

Inaccuracy

Inaccuracy depends on the following factors:

$$\pm \frac{\text{resolutions}}{\text{FREQ, PERIOD or WIDTH}}$$

± rel trigger error ±
± rel time base error

Relative Trigger Error:

$$\pm \frac{\text{noise voltage A (Vpp)}}{\text{signal slope A (V/s)} \times \text{meas time}}$$

Relative Time Base Error:

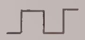
$$\pm \frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$$

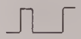
For WIDTH measurements on non-symmetrical signals, the error caused by wrong trigger level setting should be added.

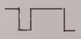
Input Specifications

Input A

Frequency Range: 10 Hz...120 MHz, typically...160MHz
Sensitivity:
Sine: 10 mV rms, 10 Hz...120 MHz
Pulse: 30 mV pp, 0 Hz...120 MHz Minimum pulse duration: 4 ns
Sensitivity decreases to 30 mV rms at 160 MHz typically
Coupling: AC
Impedance: 1 MΩ/30 pF
Attenuation: Continuously variable in two ranges between x1...x400
Filter: Switchable 50 kHz low pass noise filter with a suppression of 20 dB at 200 kHz
Trigger Levels: 3 different levels for triggering on signals with various duty factors, and AUTO


: symmetrical input signals, should be selected for input signals with a duty factor of 0.25...0.75.


: positive pulses, for input signals with duty factor <0.25.


: negative pulses, for input signals with duty factor >0.75.

AUTO Trigger Level: The counter will make test settings and automatically select the best trigger level setting. Auto requires repetitive signals with a repetition rate <100 Hz. Auto is not active in Totalize A measurements
Maximum Voltage Without Damage: 350V (DC and AC peak); DC to 440 Hz falling to 11V rms at 1 MHz

Input B (Option PM 9608B):

Frequency range: 70MHz...1.3GHz
Coupling: AC
Operating input voltage range:
10 mV rms...12V rms; 40...900MHz
15 mV rms...12V rms; 900...1100MHz
40 mV rms...12V rms; 1100...1300MHz

AM Tolerance: 94% at max 100 kHz modulation frequency. Minimum signal must exceed minimum operating input voltage requirement.
Input impedance: 50Ω nominal, VSWR <2:1
Max voltage without damage: 12 Vrms; overload protection with pin diodes

Input B (Option PM 9615):

Not available in all countires
Frequency range: 100MHz...1.0GHz
Operating input voltage range:
10 mV rms...12 Vrms; 100...900 MHz
15 mV rms...12 Vrms; 900...1000 MHz
For all other specifications, see PM 9608B

Input C:

(External reference input). The input automatically detects when a suitable external reference signal is connected. The use of an external reference signal is indicated on the display
Input Frequency: 10 MHz ±0.1 MHz
Coupling: AC
Sensitivity: 500 mV rms
Input Impedance: Approximately 300Ω at 10 MHz
Max Input Voltage: 15V rms

General Specifications

Power Requirements

Line Voltage: 115 or 230V rms 46...440 Hz, ±15% (<20 VA including all options)
Safety: According to IEC 348 Class I and CSA 5568
Line Interference: Below VDE 0871 B and MIL-STD-461
Battery Unit: See PM 9605 Option

Timebase

Crystal Version:	**Standard**	**MTCXO**
Stability Against:		
Aging: per month per year	 $<5x10^{-7}$ $<5x10^{-6}$	 $<1x10^{7}$ $<5x10^{-7}$
Temperature Changes 0...50°C	$<1x10^{-5}$	$<2x10^{-7}$
Line Voltage Changes 10%	$0<1x10^{-8}$	$<1x10^{-9}$

Display

Readout: 9 digit LCD display with unit and cursor indication
GATE: Indicates that the counter is busy measuring
REMOTE: Indicates when control over the counter is taken by an installed GPIB interface PM 9604

Dimensions and Weight

Size: 186mm W x 88mm H x 270mm D (7.3 in W x 3.5 in H x 10.6 in D)
Weight: 2.1 kg (4.6 lb)

Cabinet: The counter is housed in a metal cabinet, to achieve good EMC characteristics and mechanical stability

Environmental

Temperature
Operating: 0°C...+50°C
Storage: -40°C...+70°C
Altitude:
Operating: 5000m (53.3 kN/m2
Storage: 15,000m (15.2 kN/m2)
Humidity:
Operating: 10%...90% RH (no condensation)
Storage: 5%...95% RH

Auxiliary Functions

Reset

The RESET-button has three functions

1. **RESET**. Starts a new measurement. The settings are not changed.
2. **LOCAL**. Makes the counter go to LOCAL operation, when in remote operation (unless Local Lock-Out is programmed).
3. **START/STOP**. Opens/closes the gate in TOTALIZE A MAN mode.

Measuring Time

A measuring time of 0.2s, 1s, 10s or Single can be selected.

Displ Hold/Store A_0

The Displ Hold/Store A_0 button has two functions:

1. **DISPL HOLD:** The current measuring result is frozen on the display. A new measurement starts when Reset button is pressed.
2. **STORE A_0:** This function is active in Frequency A measurements only. When the button is pressed for >1s, the result on the display is stored as the constant A_0, which is used for the calculation of frequency difference ($A-A_0$) and ratio (A/A_0).

Blank Digits

This function blanks any number of least significant digits on the display, in order to hide unstable display digits

Optional Accessories

GPIB-Interface PM 9604

Mounting: Inside counter cabinet
Interface Functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2
Programmable Device Functions:
Measuring functions
Measuring time
Trig level offset selection
Trigger slope
Manual totalize gate control
Output separator selection
Device clear
Device trigger
Set time-out
High speed dump
Short output format
Free run/triggered measurements
Set SRQ-mask
Program data out
Device identity
Max. Data Output Rate:
Normal Mode: Approx 5 readings/s
High Speed Dump: Approx 100 readings/s
The highest output rate is obtained at SINGLE measuring time
High Speed Dump: The contents of the counting registers are transferred to the controller without being processed by the counter; the processing must be done in the controller. Max. data output rate: 100 readings/s.
Output Time for Measuring Data
Normal Mode: Approx 9 ms (20 bytes)
High Speed Mode: Approx 4 ms (15 bytes)
Response Time for Addressing: Approx 1 µs
Response Time for Trigger Command (GET): Approx 10 ms
Typical Read Time for Programming Data: Approx 1 ms/byte

Battery Unit PM 9605

The PM 9605 is a rechargeable battery unit for mounting inside the counter. The unit contains a standard 6V sealed lead-acid battery.
Battery Capacity (20°C): Approx 15 Wh, sufficient for 2 hours continuous counter operation
Recharging: The battery unit is continuously recharged from the counter in line mode operation (overcharge protection circuitry is built-in)
Recharging Time: 5 hours to approx 75% of full capacity
Battery Protection: Overcharge protection and auto shutoff to protect the battery from deep discharge
Temperature
Operating: 0°C...+40°C
Storage: -40°C...+50°C
Weight: 0.8 kg (1.7 lb)

Rackmount Kit PM 9606

The PM 9606 rack kit is designed for use with the PM 6665/6/9 family of counters. The HM 9609/01 allows mounting of one counter on the left of the rack and a blank panel or a Philips PM 2534/35 DMM on the right.

Carrying Case PM 9609

The PM 9609 is a leather-like carrying case,for protection of the counter during transportation.
Included with the instrument: Operator Manual, line cord.

PM 6669

Ordering Information

Model

January 1989 prices

PM 6669 120 MHz Universal Frequency Counter	$775

Optional Configurations

When ordering, select basic "PM" model desired from above, plus construct a 3-digit/suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.

Input Frequency Option

/0-- Standard 120 MHz	N/C
/4-- 1.3 GHz (PM 9608B/00)	add 310

Reference Oscillator Option

/-1- Standard	$N/C
/-3- MTCXO (PM 9607/00)	add 240

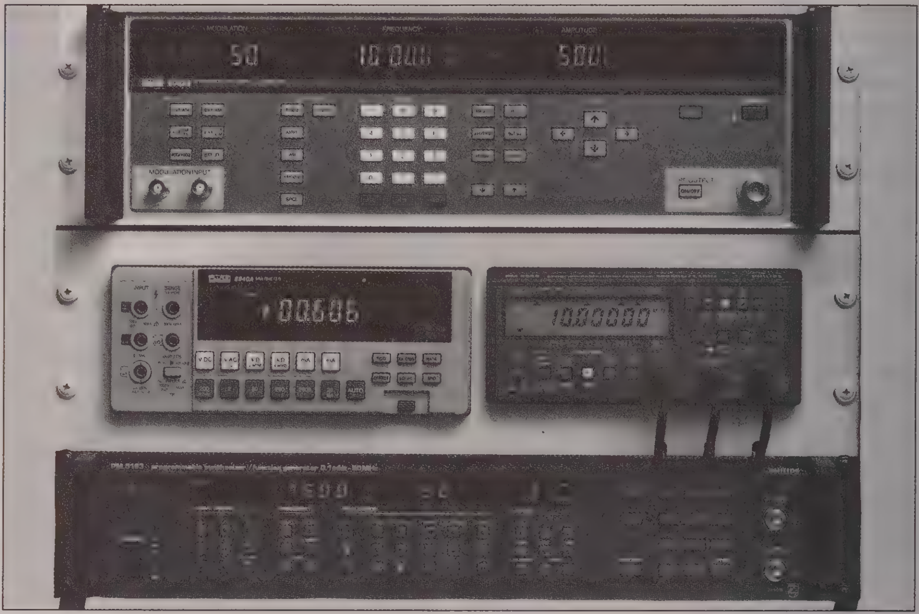
Interface Option

/--1 Standard line voltage, non GPIB IEEE-488	N/C
/--3 Battery (PM 9605/00)	add 245
/--6 GPIB IEEE-488 (PM 9604/00)	add 295

Example, Ordering Configurating

To order the PM 6669 with standard 120 MHz input, MTCXO Oscillator, and no interface, select:

		Price
Model	PM 6669	$775
Configuration		
Option Suffix - Input	/0--	N/C
Oscillator	/-3-	240
Interface	/--1	N/C
Yields Complete Model Number	PM 669/031	1015



Options & Accessories

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PM 9585/01 50Ω Termination, 1W	30
HM 9606/01 Rack kit for PM 6669	90
HM 9606/00 Rack kit for PM 6669 and 8840/2 or PM 2534/35 DMM	95

All options can be field installed by the user.
Note: Options PM 9604 and PM 9605 cannot be installed together in a PM 6669 Counter.

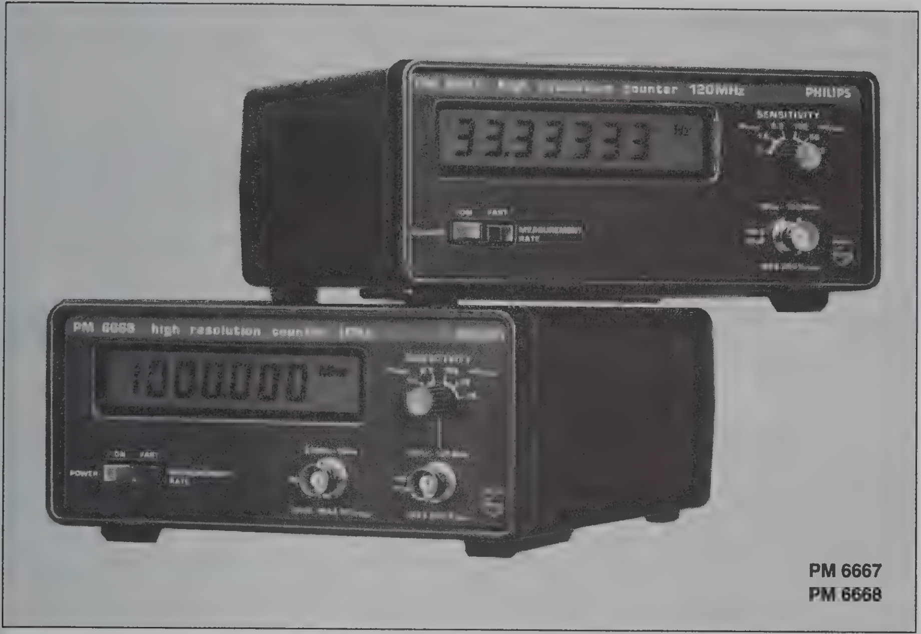
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

PM 6667 & PM 6668


PM 6667 High frequency counter 120MHz
PHILIPS
33.33333
SENSITIVITY
MEASUREMENT RATE
PM 6668 high resolution counter
1000.000

PM 6667
PM 6668

PM 6667/PM 6668 Reciprocal Frequency Counters

- High resolution computing counters
- Built-in intelligence for easy operation
- Auto triggering on all waveforms and duty cycles
- 15 mVrms sensitivity
- High-stability crystal oscillators: 10^{-7}/month
- Clear high-contrast liquid crystal display
- Line and battery operation

The microprocessor-controlled, high resolution counters PM 6667 and PM 6668 span a wide frequency range of 10 Hz to 120 MHz and 10 Hz to 1 GHz, respectively, with excellent economy. Operation is fast and the available computing power provides very high resolution capabilities normally associated with more expensive instruments.

The design incorporates an advanced technology microprocessor and dependable, large-scale C-MOS digital circuitry with fully integrated front ends which will handle a wide range of input signal voltages. Thus, the benefits of electronic performance are accompanied by a vastly reduced component count. As a result, reliability and performance are increased, size and cost reduced.

Automatic Triggering on all Waveforms

No counter is better than its front end circuitry, therefore special attention has been given to facilitate accurate and easy triggering. The multi-step attenuator allows attenuation of noisy input signals, giving a noise-immunity up to 10 dB better than with normal x 10 attenuators.

Another state-of-the-art feature is automatic trigger level setting. Depending on the input signal waveform, the counter sets automatically the required (+, 0, -) trigger level. Correct triggering is ensured without tiresome manual adjustments, for sinewaves and also for both high and low duty cycle pulses. In addition to these advanced features, the PM 6668 1 GHz front end has automatic PIN-diode attenuation, featuring automatic triggering and excellent excessive input signal tolerance.

High Resolution Computing Counter

By making a multiple period measurement and computing the reciprocal value, these counters perform high resolution frequency measurement on low frequency signals.

The microcomputer thus eliminates the traditional ±1 input cycle error and avoids the need for long gate times or period measurements or the limitations of phase-locked frequency multipliers.

Choice of two measurement times optimizes the measurement rate to the application. In the NORMAL mode, a seven digit resolution measurement is made every one second.

The FAST mode allows the user to follow changing frequency values (as for circuit trimming) and gives a full six digit resolution every 200 ms.

Greater User Convenience

In addition to automatic triggering, these counters bring excellent readout convenience by eliminating manual range selection. Independent of the input frequency, maximum resolution is assured, without any risk of overflow.

This capability plus indication of Hz, kHz, MHz and proper decimal point positioning is accomplished by the microprocessor. Easy readout is ensured by the clear, high-contrast liquid crystal display with large 11.5 mm digits.

Ideal for Field Use

Both counters are packed in a rugged, high temperature and impact resistant polyphenylenoxide case, containing a completely shielded metal inner construction.

The lightweight yet compact construction together with an optional battery pack and carrying case make these counters ideal for portable field use. A full battery charge gives approx. 5 hours of uninterrupted operation.

Some 15 minutes before recharging is needed, a low battery indication 'LO BAT' is given on the LCD display.

Self-Diagnostics

After switch-on a self test routine is executed. Should an error be detected, it is shown on the display by a diagnostic code, explained in the manual.

Quality without Compromise

These compact counters have been designed to the highest possible reliability standards. They employ a PHILIPS CMOS LSI and a single chip microcomputer that contribute to the excellent MTBF of 40000 hours.

Specifications

Frequency Measurements

Frequency Range
PM 6667: 10 Hz ... 120 MHz.
PM 6668: 10 Hz ... 1 GHz

PM 6667 & PM 6668

LSD Displayed
The unit value of the Least Significant Digit displayed is:
In Normal Display Mode:

$$\frac{\leq 5}{10^7} \times \text{FREQUENCY}$$

In Fast Display Mode:

$$\frac{\leq 2.5}{10^6} \times \text{FREQUENCY}$$

(rounded to nearest decade, e.g. 0.4 Hz will be 0.1 Hz, and 0.5 Hz will be 1 Hz)

Resolution: 1 LSD unit
Inaccuracy (relative frequency error):

$$\pm \frac{\text{LSD}}{\text{input frequency}} \pm \text{rel. trigger error}$$

$\pm$ time base error

Rel. Trigger Error
For any Wave Shape:

$$\frac{\text{Measurement rate}}{\text{Signal slope (V/s)}} \times \text{peak-to-peak noise voltage}$$

For Sinewaves:

$$\frac{\text{Measurement rate}}{\text{Input frequency} \times \pi \times \text{S/N ratio}}$$

Example: for S/N ratio of 100 (40 dB) and sample rate of 1 measurement/s, the trigger error is:

$$\frac{3 \times 10^{-3}}{\text{input frequency}}$$

Input Specifications

Measuring Inputs

Input Sensitivity: (In 15 mVrms position)
LF-Input: 15 mVrms sinewave; 100 Hz...75 MHz
25 mVrms sinewave; 10 Hz...120 MHz
45 mVpp for pulses with a pulse duration of ≥7 ns
RF-Input: (PM 6668 only)
15 mVrms sinewave; 70 MHz...800 MHz
25 mVrms sinewave; 800 MHz...1 GHz
Input Attenuation:
LF-Input: x 1 to x 300 in 6 positions
RF-Input: Automatic attenuation
Trigger Level: A fixed (+, 0 or -) voltage is automatically applied to ensure proper triggering on any waveform and duty cycle.
Coupling: AC
Input Impedance:
LF-Input: 1 MΩ//≈25 pf
RF-Input: 50Ω nominal with VSWR <2 (PM 6668 only)
Max. Input Voltage Without Damage:
DC: 300V
AC: 260 Vrms at ≤440 Hz, falling to 12 Vrms at 1 MHz

Ext. Reference Input

Frequency: 10 MHz
Input Voltage Range: 0.5 Vrms...12 Vrms
Input Impedance: 2 kΩ

Time Base

(/.1. Standard Version)
Frequency: 10 MHz
Aging: ≤5 x 10^{-7}/month
Temperature Stability: (0...50°C, ref. to +23 °C): ≤1 x 10^{-5}
(/.2. TCXO Version)
Frequency: 10 MHz
Ageing: ≤1 x 10^{-7}/month
Temperature Stability: (0...50°C, ref. to +23 °C): ≤1 x 10^{-6}

General Specifications

Display: 7 digits, 11.5 mm, liquid crystal display with unit indication of Hz, kHz, MHz and LO BAT
Measurement Rate: Normal, (out): Approx. 1 measurement/s; at frequencies below 100 Hz, the measurement rate gradually slows down to one measurement per second to reduce the trigger error influence.
Power Requirements: 115/230V, ±15%, 50..60 Hz; 15 VA or built-in optional battery pack PM 9601 or by external 12V battery.
Safety: According to IEC 348 and CSA 556 B
Dimensions: 160 mm W x 77 mm H x 180 mm L (6.3 in W x 3 in H x 7.1 in L)
Weight: 1.2 kg (2.6 lb)

Environmental Conditions

Temperature:
Storage: -40°C...+70°C
Operating: 0°C...+45°C
Altitude/Barometer Pressure:
Storage: 15000m (50000 ft)/15.2 kN/m²
Operating: 5000m (15000 ft)/53.3 kN/m²
Humidity: 10%...90% RH, (26°C dew point)

Optional Accessories

PM 9601 Battery Unit

The PM 9601 is a rechargeable battery unit for mounting inside the counters. This unit contains a standard 6V, 3 Ah sealed battery of solid gel lead-acid type and is provided with charging and overcharge-protection circuitry.
Capacity (typical at 20°C):
PM 6667: 6h of continuous operation
PM 6668: 4h of continuous operation
Recharging Time (typical at 20°C):
10h to 90% of full capacity;
5h to 70% of full capacity;
Trickle charge during operation (Power on).
Weight: 0.75 kg (1.65 lb)

PM 9602 Carrying Case

Hard-shell, high-impact ABS carrying case provides protection during transportation

Included with the Instrument: Operating manual, line cord

Ordering Information

Models

January 1989 prices

PM 6667 120 MHz Counter	$520
PM 6668 1 GHz Counter	775

Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit /suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface

Input Frequency Option:	
/0-- Standard 120 MHz for PM 6667 only	N/C
/4-- Standard 1 GHz for PM 6668 only	N/C
Reference Oscillator Option:	
/-1- Standard Oscillator	N/C
/-2- TCXO	add 180
Interface Option:	
/--1 Standard front panel only, line voltage	N/C
/--3 Battery (PM 9601/01)	add 200

Options and Accessories

PM 9601/01 Battery Pack	200
PM 9602/01 Carrying Case	40
PM 9603/01 19-in Rack/Panel Mount Adapter	75
PM 9665B/01 50 kHz Low Pass Filter BNC-BNC	35

Service & Support

Warranty
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

GPIB/IEEE-488 Instrumentation Systems

Page 365 1722A

Page 380 System 21

Page 377 PM 2260

Page 374 PM 2240 TestTeam

Page 376 PM 2230 Series

Fluke and Philips meet today's increasing need for automation in test and measurement by offering one of the widest ranges of GPIB controller instruments, industrial controllers, PC-based controllers, software tools and experienced customer support services.

The massive range of instrumentation makes it easy for the user in R&D, manufacturing and service to select the required building blocks for his application from one supplier.

Fluke and Philips anticipate the requirements of the users in R&D, manufacturing and service by offering an industrial GPIB controller for applications in manufacturing and process control demanding high speed and ease of programming. We also offer GPIB interface cards and software for PCs for applications that require flexibility and access to a wide range of software tools.

Our commitment to meet the user's requirement does not stop with products. It includes responsive customer support services which make us a uniquely qualified partner in the field of automation for test and measurement.

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Oscilloscope Signal Processing
Software 377
GPIB PC Interface Cards and
Software 378
Modular GPIB Switching System 380
FlexSys Test Software (ATLAS) 387
IEEE-488 Translator 388
System Multimeters 390
Switch Controller/Scanner 392
Power Supplies 394

Fluke & Philips GPIB/IEEE-488 Instrumentation Selection Guide

The following is a selection chart listing all the Fluke and Philips test and measurement instruments that support the GPIB/IEEE-488 bus. For more information on a particular instrument, refer to its section in the catalog.

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Fluke & Philips GPIB/IEEE-488 Instrumentation Selection Guide

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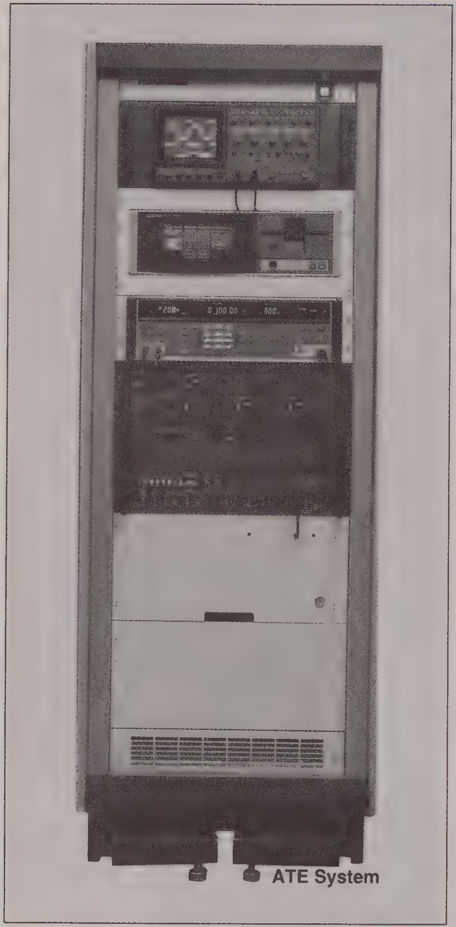
Introduction

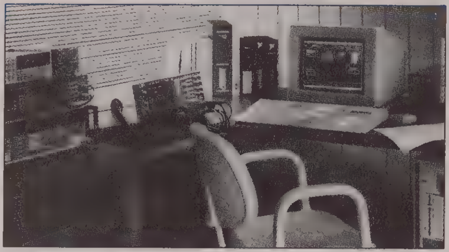
Instrumentation Systems Introduction


ATE System

Philips & Fluke & GPIB/IEEE-488

Philips and Fluke offer not only a wide range of sophisticated test and measurement instruments, but also controllers, software and switches for GPIB/IEEE-488* systems.

Philips' and Fluke's extensive experience in automated test and measurement has resulted in instruments ideally tailored for use in GPIB instrumentation systems. When combined with worldwide sales, support and training facilities, the user is assured of simple and timely set-up of his own GPIB system.



The GPIB (General Purpose Interface Bus) is equivalent to the IEEE-488 and IEC-625 busses as worldwide standards supported by all major instrument suppliers. Philips and Fluke participate in international standardization committees, improving existing standards to ensure GPIB instrumentation systems are easier to build.

Instrument Controller

The instrument controller is the central element in a GPIB instrumentation system. The test program covering instrument control, data processing/analysis and display will, in most cases, be developed and executed on the controller.

Philips and Fluke offer a number of software packages to ease programming of instruments, data processing/analysis and data presentation on screen for their dedicated and PC-based instrument controllers.

Dedicated Instrument Controller

The dedicated instrument controller is an industrial instrument controller specially designed to control the GPIB bus. Dedicated controllers can extract maximum performance on the bus and are typically used for large scale GPIB applications. Program execution speed and reliability are the key elements for a dedicated controller. Philips and Fluke offer the 1722A Instrument Controller for medium to large scale GPIB applications. The touch-screen, display, processing power and wide range of software and hardware make the 1722A suitable for industrial applications. For more information, see page 365.

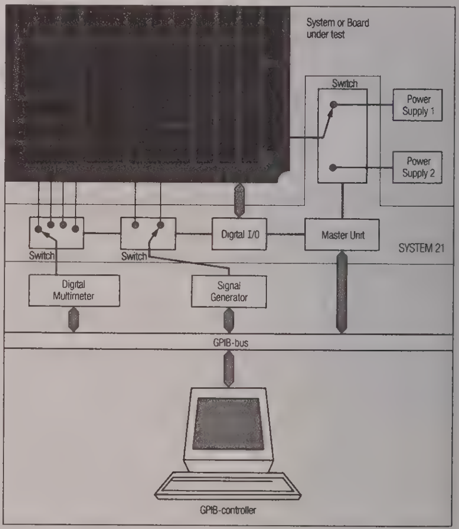
PC-based Controllers

The PC, with its excellent price/performance ratio, and wide range of software and hardware options, is now very popular as a GPIB instrument controller for small to medium-sized applications. Philips and Fluke offer GPIB interfaces for the PC/XT and AT (PM 2201, page 379) and PS/2 (PM 2202, page 379). Software is provided to ease programming, such as the PM 2240 TestTeam (page 374) and PM 2230 Series of Instrument Drivers (page 376); and the PM 2260 Oscilloscope Signal Processing Package (page 377) extends the measurement capabilities of Philips DSOs with extensive waveform analysis, display and storage functions on the PC.

Switching and I/O

Philips and Fluke offer 2 types of GPIB controlled switching and I/O systems: System 21, a modular switching and I/O system for small to medium-sized GPIB systems (page 380); and the 2205A Switch Controller/Scanner (page 392) tailored for applications in production testing, process monitoring, process automation, calibration etc.

Between them, System 21 and the 2205A cover virtually any switching applications in GPIB instrumentation systems.



The Main building blocks of a GPIB system are:

- *Instruments*
- *Switches to connect the instruments to the device under test*
- *A GPIB controller for controlling the system and processing and displaying the measured data*

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

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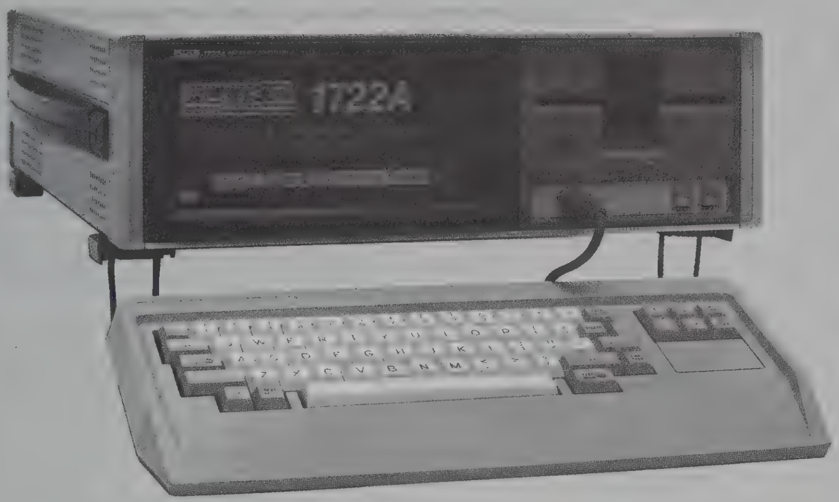
*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

1722A



1722A With Keyboard

1722A Instrument Controller

- Microcomputer architecture designed for system control
- Touch display operator interface
- BASIC, FORTRAN, and Assembly programming language options
- Rack mountable with removable keyboard
- 136K RAM memory expandable to over 3.0 megabytes
- High resolution graphics with graphics print capability
- RS-232-C, IEEE-488, RS-422, or 20 mA current loop and bit parallel interfaces
- High speed floating point processing implemented in firmware
- Soft-loaded operating system

The 1722A represents the evolution of a concept pioneered and introduced by Fluke in 1979 – the concept of using a touchscreen as the primary interface between an operator and a high-performance instrument controller. Few things could be more user-friendly. And it allowed the keyboard to be treated as a programming tool, usually unplugged and removed from an operating instrumentation system. Rack mounting was simple.

Fluke's first instrument controller was the 1720A. The 1722A has improved capabilities. But, because we are committed to maintaining the highest possible level of software compatibility consistent with evolutionary improvements, the 1722A runs programs that were developed for even the first 1720As delivered. As we continue to develop microcomputer products at Fluke, the software investments made by our customers remain a foremost design consideration.*

High Performance Microcomputer

The 1722A is a microcomputer designed for control of automated instrument systems in the laboratory, the plant, or the factory and for information management systems.

The 1722A is an entirely new design internally. The high speed 16-bit microprocessor uses a 24 MHz clock to achieve an instruction cycle rate of 6 MHz. High-speed floating point arithmetic processing is implemented through extensions o the microprocessor instruction set. A separate display processor, with high speed vector generator and graphics memory work space, functions as an independent graphics display terminal for the central processor.

When powered on, the 1722A looks to its internal floppy disk (or to optional non-volatile RAM) for operating software. Updating to newer software is a simple matter of inserting a disk and restarting. You are not tied to permanently-installed ROMs. Yet the 1722A is easily set up to automatically start running your application. After loading operating software, it looks for a start-up command file. The file is treated as keyboard inputs, instructing the controller to perform any task sequence. If software is stored in optional non-volatile RAM memory, you never need to bring a disk near it.

RAM memory in the 1722A can be partially allocated as a file-structured electronic disk, for high speed task overlays and large, fast-access virtual data arrays. Software development tools make the task of writing programs more efficient through such features as wildcard file identification, utility command files, and recall of previously typed commands.

The 1722A includes five slots for additional memory and interface options. The standard 136K RAM memory is internally expandable to over 3.0 megabytes. The 400K-byte internal floppy disk drive capacity can be expanded through the 1760A or 1761A Disk Drives to 2 megabytes of on-line floppy disk file storage. The 1765B Series of Winchester disk drives provides 20M bytes of file storage, in two models. Non-volatile RAM options can be installed for rugged, permanent file storage, especially suited for harsh environments. Up to 2.5M bytes of non-volatile memory, may be installed.

Touchscreen Display System

With its touchscreen display, the 1722A is particularly well suited for applications where semi-skilled personnel need to operate complex systems performing sophisticated tasks. The friendly graphics display takes the place of the often-intimidating keyboard, yet offers access to the software that keeps your system running. An operator is prompted one step at a time for information or decisions through informational displays, and responds by simply touching the screen. The predictability of procedures allows true trend analysis to be performed, pinpointing common failure modes or process impediments. Systems based on this concept are easily updated for new tasks. The cost and downtime of installing new switch or key labels is eliminated.

Fluke's experience producing the touchscreens goes back to 1979. It has proven to be a rugged, reliable component.

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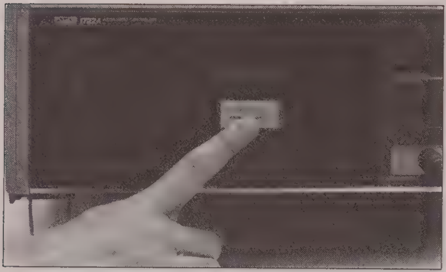
* *The 1722A has been incorporated into a number of Fluke calibration systems. See pages 212 through 226.*

1722A



Touchscreen interactive display

Characters Plus Graphics

The graphics display capability of the 1722A is independent of its character display, and of the 1722A central processor. With its own display processor, high speed vector generation hardware, and 64K graphics display memory, the 1722A is a sophisticated tool in the hands of the creative system designer. The 64K display workspace is over three times the size of the 640 by 224 pixel display window: 2048 pixels wide by 256 pixels high. You can use it to display data in strip chart form, and move the display across the window by touch commands. You can also use it to prepare up to three independent data screens available for instant display. Once the graphics display is generated, a hard copy of the graphics plane can be printed under program control.

The 1722A character display is an independent function that can overlay graphics data displays for labels, or be used alone for test and for programming. Because the graphics and character displays can be independently enabled, screens can be prepared "off-line" and displayed when ready. Numerous ANSI-compatible character attributes are available to add emphasis to portions of displays. Attributes such as inverse or underline can be pre-defined for display fields, or made a part of characters as they are sent to the screen.

The 1722A includes an industry standard composite video output that will display what ever is on the 1722A screen on a video monitor. This can be useful for training presentations as well as for system requirements that include a remotely mounted display.

Interfacing

The 1722A includes an IEEE-488 bus interface port and an RS-232-C serial port. The IEEE-488 interface can control up to 14 instruments at transfer rates of up to 30K bytes per second. Powerful IEEE-488 commands are supported as a part of each 1722A programming language. The 1722A can be set up to function as a system controller or as an addressable device in a multiple-controller system. In either configuration, the 1722A can pass control to another controller and take it back when offered. As system controller, the 1722A starts up as controller-in-charge and can use IFC (Interface Clear) to reset all bus devices.

Three of the five expansion slots are available for additional interfaces:

Option 17XXA-008 adds an additional IEEE-488 interface and an additional RS-232-C serial data port. The 1722A can accomodate up to four IEEE-488 ports.

Option 17XXA-009 is a reconfigurable, dual serial port with its own buffer memory. It is supplied configured for RS-232-C with full modem compatibility. Each port can be easily reconfigured for a 20 milliamp current loop, or for RS-422 balanced lines. Up to three -009s may be installed for a total system of seven serial ports.

Option 17XXA-002 (Parallel Interface) gives you two independent 16-bit parallel I/O ports that can function as independent lines, 8-bit bytes, or 16 or 32-bit words. Line protocol is available (but not required), and the sense of the data can be reconfigured to either High true or Low true. A maximum of three modules may be installed for a total of six 16-bit ports.

Options & Peripherals

RAM Memory Expansion Modules (-006, -007, -016, -017)

Internal program and data space may be expanded to over 3M bytes with RAM expansion options. Memory may be added in the following increments:

17XXA-006	256K bytes
17XXA-007	512K bytes
17XXA-016	1M bytes
17XXA-017	2M bytes

Application programs can assign any part of this memory to function as an "Electronic Disk." Programs and data may be loaded to this E-Disk, allowing faster transfer rates and no disk wear.

Non-volatile RAM Options (-018, -019, -020)

These options provide either 256K bytes (-018) or 512K bytes (-019) or 1M bytes (-020) of file-structured, non-volatile RAM memory. Transfer rates are comparable to RAM -- over 1M bytes per second. Up to 5M bytes non-volatile RAM may be installed in the 1722A.

Non-volatile RAM is solid-state medium which is immune to pollution and vibration, making it ideal for harsh environments where floppy disk operation is not practical. Non-volatile RAM is battery backed up for up to five years to retain its file contents through a power loss. Since non-volatile RAM has a much greater tolerance to temperature extremes than other media, the 1722A can operate from 0°C to 40°C when non-volatile RAM is the primary file storage medium. Non-volatile RAM provides a write protection switch to protect its file contents.

Internal Winchester Disk Drive

John Fluke Mfg. will be introducing an internal winchester disk drive for the 1722A in April 1989. For further information please contact your local Fluke Sales Eingineer or Representative.

External Floppy Disk Drive Systems (1760A and 1761A)

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage. The 1760A and 1761A use double-density dual-head disk drives. The full on-line capacity is 400K bytes for the 1760A, and 800K bytes for the 1761A, including a file directory for each floppy disk. They interface to the 1722A via the IEEE-488 port. Both systems are rack mountable and easy to install and use. Transfer rate is 22K bytes per second. Up to two 1761As can be accommodated, for a total of 2M bytes of on-line floppy disk file space.

External Winchester Disk Drive

The 1765B Series of Winchester disk drives provides high-capacity hard disk file storage for the 1722A Instrument Controller:

1765B/20 20M byte Winchester Disk Drive
1765B/20M Multi-User 20M byte Winchester Disk Drive

Both models provide for easy connection to the 1722A Instrument Controller through a standard IEEE-488 interface, and are rack-mountable, using the optional rack-mount kit. More information is available in the following "Disk Drive" section.

Floating Point Math Coprocessor

John Fluke Mfg. will be introducing a floating point math coprocessor for the 1722A in April 1989. For further information please contact your local Fluke Sales Engineer or Representative.

Software

For information regarding 1722A Software, see the following "Software" section.

Module-Level Diagnostics

The 1722A is a modular design with diagnostic software that allows semi-skilled operators to identify failures to the module level. Spare-module kits are available for the most time-critical applications. Fluke also maintains an inventory of 1722A modules that may be shipped within hours in most cases, and which can be exchanged for a defective module for a nominal charge. Contact your Fluke Technical Service Center for more information.

Manuals That Make the Task Easy

Experience will tell you that the major investment in an automated instrument system is not in the hardware, but in system integration and the development of application software to run it. The quality of documentation is a key consideration. You will find that 1722A manuals are among the most readable, consistent, and sensible software documentation available anywhere. Ask your Fluke Sales Engineer or Representative to let you evaluate the 1722A through its manuals. You will be pleasantly surprised.

OEM Sales 1722A in Your Products

The 1722A is used as a component part of many products manufactured by companies other than Fluke. Custom packaging and matching paint colors are routinely negotiated. Fluke offers the discounts, policies, and worldwide support to make it work, too. If you are designing a product that would be more competitive with a touchscreen and a high performance microcomputer system, call your Fluke Sales Engineer or Representative for more information.

Specifications

Temperature: 10°C to 40°C with floppy disk, operating; 0°C to 40°C without floppy disk, operating. 10°C to 52°C with floppy disk, non-operating; -20°C to 60°C without floppy disk, non-operating

Relative Humidity: 20% to 80% non-condensing, operating; 8% to 90% non-condensing, with floppy disk, non-operating or 5% to 95%, non-condensing, without floppy disk, non-operating

EMI and RFI Emissions: Tested to FCC Part 15, Subpart J, Class B; VDE 0871, Class B; CISPR 11-1975

Power: 90V to 132V ac or 180V to 264V ac, 47 Hz to 440 Hz. 175W maximum

Size: 13 cm H x 43 cm W x 55 cm L (5.25 in x 17 in x 21.5 in) plus feet

Weight: 14.5 kg (34 lb). Keyboard 1.4 kg (3 lb)

Included: Y1700 Keyboard, power cord, BASIC system disk, diagnostic disk, "Getting Started" manual and disk, System Guide manual, Operator's manual, BASIC Programming Manual, and a pad of 50 display worksheets

Ordering Information

Model

January 1989 Prices

1722A Instrument Controller	$6990
1722A-1 Instrument Controller w/o Keyboard	6790

Options (for 1722A & 1722A-01)*

-002 Dual 16 Bit Parallel Interface	990
-006 256K-Byte RAM Expansion	1000
-007 512K-Byte RAM Expansion	1400
-008 IEEE-488/RS-232 Interface	850
-009 Dual Serial Interface	990
-016 1M-Byte RAM Memory Expansion	1800
-017 2M-Byte RAM Memory Expansion	3200
-018 256K-Byte Non-Volatile RAM	1700
-019 512K-Byte Non-Volatile RAM	2700
-020 1M - Byte Non-Volatile Ram	3700

Language Systems (See page 368)

-200U System S/ W Update	150
-201 Assembly Language Development System	1495
-202 FORTRAN Development System	1495
-203 Compiled BASIC Development System	490
-205 Extended BASIC Development System	490
-912 Non-ANSI C Development System	1995
-913 Non-ANSI C Compiler	1495

Software Options (Also see page 368)

-900 Software Binder	30
-901 Gabby	195
-902 Touchscreen Toolbox	295
-903 Compiled MenuBASIC	295
-905 Extended MenuBASIC	295
-907 Transport±PC	450
S1703 Compiled MenuBASIC Development Package	1900
S1705 Extended MenuBASIC Development Package	1900

Peripherals

1020 Touch Control Screen (includes a desk-top enclosure)	1820
1021 Touch Control Screen	1695
1760A 400K Byte Disk Drive	1950
1761A 800K Byte Dual Disk Drive	2950
1765B/20 20M Byte Winchester Disk Drive	3295
1765B/20M Multi-User 20M Byte Winchester Disk Drive	on req
1780A InfoTouch® Display	2150

Accessories (Also see page 485)

Y1700 Programmer's Keyboard	395
Y1702 2m RS-232-C Null Modem Cable	125
Y1703 4m RS-232-C Null Modem Cable	150
Y1704 Circuit Board Extender	200
Y1705 0.3m RS-232-C Null Modem Cable	75
Y1706 Double-Sided Blank Disks (package of 10)	60
Y1707 2m RS-232-C Interface Cable	125
Y1708 10m RS-232-C Interface Cable	150
Y1709 2m Printer Cable	125
Y1790 Rack Mount Kit w/24" Slides	195
Y1795 Carrying Handle for portability	48
Y8021 1m Interface Cable for IEEE-488 bus	130
Y8022 2m Interface Cable for IEEE-488 bus	145
Y8023 4m Interface Cable for IEEE-488 bus	155

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1722A Repair	221

GPIB
IEEE-488

1700 Series Software

The power of any computer system lies in the software that is supported with the system. The 1722A Instrument Controller and 1752A Data Acquisition System support a variety of software development systems, utilities and applications packages. Each package is designed to help the programmer develop software to fit the system to his particular application. Fluke also offers training and consulting services to help get your system up and running in the shortest possible time.

System Software

- File Utility Program
- SET
- Alias File
- Command Files
- TCOPY
- EDIT
- SHELL

Fluke's FDOS operating system combines the best features of both benchtop computers and minicomputers. Like a benchtop unit, the user can power-up the system and immediately begin programming in BASIC. No further knowledge of the operating system is required. For the advanced programmer, powerful utilities allow the user to perform complex functions with a minimum of keystrokes. Features include:

File Utility Program — Simplifies management of file structured devices such as the floppy disk, or bubble memory. Its concise, simple commands allow the user to transfer the contents of files or whole disks with a single command. Other features include wildcards, interactive commands, and file protection.

SET — Allows software set-up of serial port communications parameters, including baud rate, timeouts, and XON/XOFF handshaking.

Alias File — Allows the user to define his own commands for the system.

Command Files — Allows the user to define command sequences for the system. Flexible features allow the user to develop interactive sequences which can interface with the operator through either the keyboard or the touchscreen. Command files may also be used to automate the controller's start-up sequence.

TCOPY — The touch copy utility allows the user to perform file management through the touchscreen. It allows copying of files by name, date of creation, etc.

EDIT — The system editor is a powerful screen editor, with capabilities for searching, replacing, and cut-and-paste.

SHELL — The user may set the default console program with the SET SHELL command. This allows the programmer to design a system where his application program is the only software that the operator can see.

Other utilities allow the user to configure the operating system, check compatibility between various versions of software, and set the time and date through the touchscreen.

Language Systems

- Interpreted BASIC
- Compiled BASIC
- Extended BASIC
- FlexSys Test Software (ATLAS)
- Assembly Language
- Non-ANSI C
- FORTRAN

BASIC

The 1700 Series supports three BASIC packages. Compiled BASIC and Extended BASIC are available as options. Each package provides the programmer with the development tools necessary to take on the task of developing industrial control systems.

Compiled BASIC

The 17XXA-203 Compiled BASIC Option provides greater flexibility and speed while maintaining the ability to compile Fluke Interpreted BASIC. Programs can be run three to five times faster with Compiled BASIC than with Fluke Interpreted BASIC, while using less memory. Compiled BASIC includes the capability of linking subroutines in FORTRAN or Assembly Language.

Compiled BASIC permits large multiple-line statements, and long descriptive variable names. It also permits labels to be used in place of line numbers for branch targets while leaving the use of line numbers optional. Compiled BASIC subroutines exchange parameters, and use local variables and common variables for true modularity. This freedom of format allows BASIC programs to be written in a readable, structured form. Multiple-line statements can be especially useful, for example, when a program requires many lines following an IF statement. Key features include:

- Program execution 3 to 5 times faster
- True subroutines with local variables
- Use of program overlays for large programs
- Three dimensional arrays
- Alphanumeric labels for lines and/or statements
- Long variable names
- Continuation lines — up to 200 lines per line number
- Powerful screen editor

Extended BASIC

The 17XXA-205 Extended BASIC Option provides a compiler that allows the 1722A programmer to easily develop large BASIC programs without having to use a complex overlay structure that can be required when using Fluke Compiled BASIC. (Program space can be over two megabytes.) The statements and syntax are the same as those found in our Compiled BASIC. Key features include all those mentioned for Compiled BASIC except execution speed is only twice as fast as Fluke Interpreted BASIC, while eliminating complex program overlays.

Comparison of Fluke BASIC Offerings

Feature	Interp'd BASIC	Compiled BASIC	Extended BASIC
Program Size	28K bytes	35K bytes	>2M bytes
Execution Speed Ratio (appx)	1	3-5	2-3
Program Expansion Method	Chaining	Overlays	None req
Immediate Mode Commands	Yes	No	No
3-D Arrays	No	Yes	Yes
Continuation Lines	No	Yes	Yes
Long Variable/ Statement Names	No	Yes	Yes
True Subroutines	No	Yes	Yes
Program Libraries	No	Yes	Yes
Option To Omit Numbers	No	Yes	Yes
Input Line Statement Capacity	80	510	510
Import/Export Statements (Global Variables)	No	No	Yes
Step Mode Debugging	Yes	No	No

FORTRAN

The Fluke 17XXA-202 offers a complete system for development of FORTRAN programs or subroutines with performance rivaling many minicomputers. Fluke FORTRAN makes it easy to use the features of the 1700 Series. Libraries provide routines for numeric and text manipulation, touchscreen and graphics support, and communications, including GPIB/IEEE-488*. Fluke FORTRAN can also interact with the operating system to provide functions such as file management and interaction with the system's command line interpreter.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Typical Statement Execution Times

	BASIC	Compiled BASIC	FORTRAN
Math Functions Execution Time, msec*			
= (Assignment)	0.460	0.152	0.004
+	0.474	0.353	0.237
—	0.477	0.353	0.224
*	0.506	0.383	0.209
/	0.682	0.554	0.221
≜	4.821	4.652	2.902
SIN	2.301	2.052	1.332
COS	2.431	2.202	1.242
TAN	4.771	4.512	2.802
ATN	3.361	3.122	1.422
SQR	1.611	1.382	0.842
LOG	2.351	2.112	1.462
LN	2.461	2.222	1.542
EXP	2.411	2.172	1.512
Control Statements			
FOR Loop (integer counter)	0.189	0.076	0.004
IF-THEN	0.622	0.121	0.110
GOSUB/RETURN	0.254	0.142	0.036

**Data may vary depending on application*

Assembler

The 17XXA-201 allows the programmer to develop high speed or specialized routines in assembly language. The package includes a structured preprocessor which allows the use of high level constructs for program flow control. Using Macrostore*, double- and single- precision floating point arithmetic instructions become part of the language, simplifying code development. Also provided is the Hex Debugging Tool (HDT), with disassembly capability to speed program development.

C

The 17XXA Non-ANSI C Development System supports features such as user defined data structures, full complement of math functions, bit fields, string manipulation and Whitesmith I/O. For real-time and instrument control applications, the system supports a full complement of interrupt processing structures, IEEE-488 I/O commands, and a complete interface to the FDOS operating system.

This package requires the 17XXA-201 Assembly Language Development System. Due to this, the package is available two ways; as the 17XXA-913 Non-ANSI C Compiler or as the 17XXA-912 C Development System, which includes both the 17XXA Non-ANSI C Compiler and the 17XXA Assembly Language Development System.

FlexSys Test Software (ATLAS)

To speed development and reduce software maintenance costs of test systems, the ATLAS language is available for the 1722A. More information is available in the following FlexSys section.

Linkers and Library Management

Linking and Library Management utilities are provided standard with the following software packages:

- 17XXA-201 Assembly Language Development System
- 17XXA-202 FORTRAN Development System
- 17XXA-203 Compiled BASIC Development System
- 17XXA-205 Extended BASIC Development System

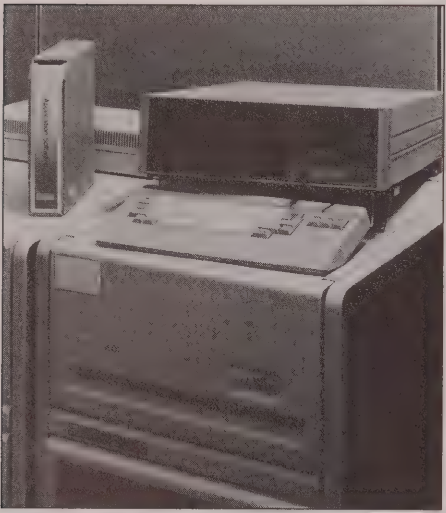
Fluke's Linking programs allow the user to modularize his program, by compiling routines one at a time, and then linking the final software package. This simplifies the management of projects requiring multiple software engineers. Support for overlays is offered through the Linkage Editor. The Library Manager may be used to build libraries of user defined routines.

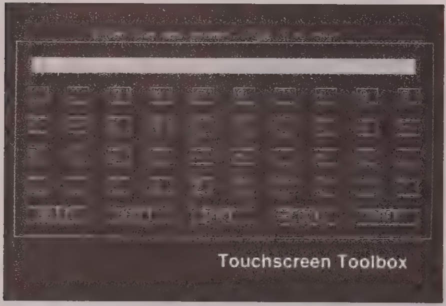
**Macrostore is a trademark of Texas Instruments Incorporated.*

Selection Guide — Language Systems

Language	Item Number	Program Space	Data Space	Touch-screen Support	IEEE-488 Support	Comments	Compilation speed (stmts/min)	Real-Time Interrupts	Hardware
BASIC									
Interpreted	n/a	28K bytes [1]	to 3M bytes	Std	Complete		n/a	Yes	
Compiled	17XXA-203	35K bytes [1]	to 3M bytes	Std & Adv [3]	Complete	Structured BASIC	~2400	Yes	17XXA-016 1M byte RAM [2]
Extended	17XXA-205	to 3M bytes	to 3M bytes	Std & Adv [3]	Complete	Structured BASIC	~2400	Yes	17XXA-016 1M byte RAM [2]
FORTRAN	17XXA-203	64K bytes [1]	to 3M bytes	Std	Complete	FORTRAN IV	~300	No	17XXA-016 1M byte RAM [2]
Assembler	17XXA-201	64K bytes	64K bytes	Std	Std	Hex Debugging Tool Provided	~4500	Yes	
Non-ANSI C	17XXA-912	64K bytes [1]	to 3M bytes	Std	Complete	Whitesmith C I/O	~1000	Yes	17XXA-016 1M byte RAM [2]

[1] *Can be increased using overlays or chaining*
[2] *Recommended hardware*
[3] *Advanced Support available through Touchscreen*





Fluke Application Software

- Gabby
- Touchscreen Toolbox
- MenuBASIC
- TransPort—>PC

Gabby

The Gabby Terminal Emulation Program (17XXA-901) is a communications program which provides a simple method of transferring 1700 Series files to and from almost any host computer. Gabby emulates a terminal attached to the host computer and also allows uploading and downloading of files between the 1700 Series and the host computer. With Gabby, all commands are accessed through the touchscreen, relieving the user from the task of learning cryptic command sequences. Gabby includes three appendices showing step by step instructions for use with the UNIX*, RSTS*, and VAX/VMS*.

Touchscreen Toolbox

Fluke's expertise in developing human interfaces using the touchscreen is made available to the programmer through the 17XXA-902 Touchscreen Toolbox package. The package cuts the time required to develop a menu based system, while ensuring that the resulting menus will be simple for the operator to use. The package also includes calculator-style and alphanumeric keypads to simplify the tasks of entering data such as process control parameters, operator identification, or serial numbers.

MenuBASIC

MenuBASIC is a tool designed to simplify the task of developing programs for the 1700 Series. It provides access to a powerful BASIC language, complete with advanced structures such as CASE statements and true subroutines, and features designed to simplify systems development such as full IEEE-488 support and multilevel interrupt structure. MenuBASIC also features a powerful editor which can search, search and replace, and merge programs interactively.

MenuBASIC makes these and other features easy to use by allowing the programmer to select actions from a menu presented on the screen. Memorizing the commands is not required, since they are displayed on the screen as part of the menu. This makes learning how to use MenuBASIC a simple task, as well as allowing single key commands to perform functions which require long command strings on most systems.

MenuBASIC is also available as Development Packages which provide everything you need to meet MenuBASIC software and memory requirements. Both include MenuBASIC software, a manual, a 512K-Byte Memory Expansion Module, and a Compiled or Extended BASIC language package.

MenuBASIC features include:

- **BASIC Language:**
  Full IEEE-488 Support
  Multiple-Level Interrupt Structure
  Virtual Arrays
  Line Numbers Optional
  True Subroutines with Local Variables
  Long Variable Names
  Advanced Control Structures (IF-THEN, WHILE, CASE, etc.)
- **Program Development:**
  Interactive Environment
  Advance Editor with Search Replace Cut and Paste
  Interactive File Merging
  Simplified, Single Key Commands
- **System:**
  Ability to link other MenuBASIC, FORTRAN or Assembly Modules
  Full File Control (Copy, Delete, etc.)
  Complete Serial Port Control (Baud Rate, Parity, etc.)

MenuBASIC Options

17XXA-903	Compiled MenuBASIC:Compiled MenuBASIC software & manual.
17XXA-905	Extended MenuBASIC:Extended MenuBASIC software & manual.
S1703	Compiled MenuBASIC Development Package: Software and manual for Compiled MenuBASIC (17XXA-903); Compiled BASIC Language (17XXA-203) and 512K-byte Memory Expansion Module (17XXA-007).
S1705	Extended MenuBASIC Development Package: Software and manual for Extended MenuBASIC (17XXA-905); Extended BASIC Language (17XXA-205) and 512K-byte Memory Expansion Module (17XXA-007).

TransPort—>PC

TransPort—>PC is a communications software program for the 1700 Series. TransPort—>PC provides a simple method for translating any ASCII text file from a disk configured by the Fluke Floppy Disk Operating System (FDOS) into a format acceptable to the IBM PC, IBM XT, or other highly-compatible microcomputer.

TransPort—>PC allows you to combine the computing and controlling power of the versatile, high-speed 1722A and 1752A with the flexibility and resources of data manipulation programs available for the personal computer.

The export utility provided with TransPort—>PC allows you to transfer numeric virtual arrays from the 1700 Series to the personal computer. Programs such as Lotus 1-2-3® can be used to display the file in spreadsheet form or as a bar, stacked-bar, pie, line or XY graph.

Selection Guide – Application Software

Package Name	Item Number	Features	Required Hardware	Required Software
Gabby	17XXA-901	• Communication between 1722A/1752A and Host Computer • Terminal Emulation • File Upload/Download • Simple Touchscreen Menu Interface • Documentation for use with: UNIX 4.1, 4.2 BSD RSTS/RSX-11 VMS	1722A with graphics print capability (all units shipped after February 1,1985) or all 1752As	Cable to Host Computer
Touchscreen Toolbox	17XXA-902	• Simplifies development of menu-based systems • Provides numeric and alphanumeric keypads • Cuts programming time from days to minutes • Provides ergonomic menu design • Frees graphics plane for other uses	1722A/1752A	17XXA-203 Compilied BASIC or 17XX-205 Extended BASIC
MenuBASIC	17XXA-903 or S1703 [3] 17XXA-905 or S1705 [3]	• Supports Compiled BASIC (see Selection Guide for Language Systems) • Supports Extended BASIC (see Selection Guide for Language Systems) • Interactive Program Development Environment • Integrated Menu Based System • Advanced Editor • Automatic, Fast Compilation and Linking • File/Memory Management	1722A/1752A 17XX-007 512 byte RAM Expansion [1] 17XXA-016 1M byte RAM Expansion [2]	17XX-203 Compiled BASIC or 17XXA-205 Extended BASIC
TransPort-->PC	17XXA-907	• Allows transfers of data disks from 1722A/1752A to IBM-PC, IBM-XT or highly-compatible microcomputer • Transfer of numerical 1722A/1752A data files into LOTUS 1-2-3 or dBase III formats	1722A/1752A IBM-PC, PC/XT or highly-compatible microcomputer with 2 floppy drives, or 1 floppy and Winchester, 256K bytes RAM	

[1] *Required hardware*

[2] *Recommended hardware*

[3] *S1703 and S1705 Packages include 17XXA-007 512K byte RAM Expansion and all required software*

**UNIX is a trademark of AT & T Bell Laboratories*

***RSTS, RSX-11, and VMS are trademarks of Digital Equipment Corporation*

IBM is a trademark of International Business Machines, Inc.

LOTUS and 1-2-3 are trademarks of Lotus Development Corporation

dBase III is a trademark of Ashton-Tate Corporation

Ordering Information

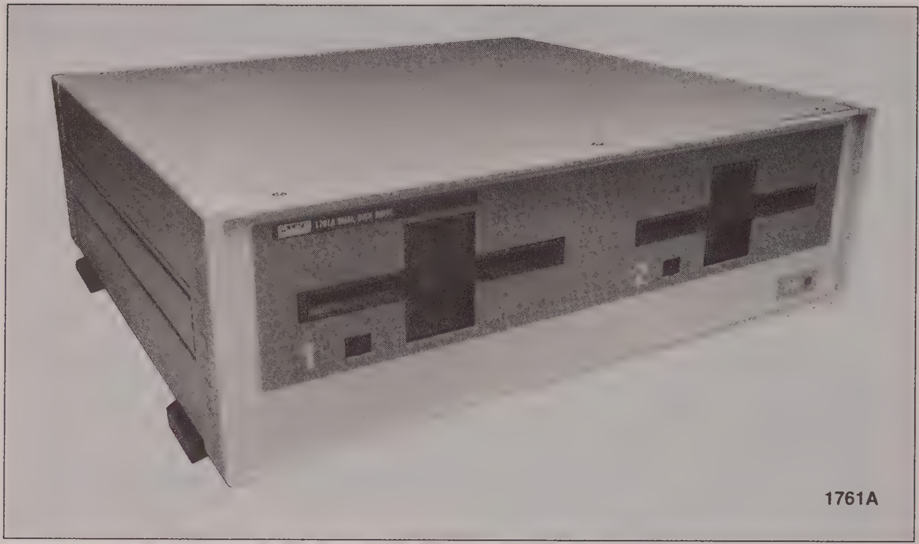
Language Systems

Item	Price
17XXA-201 Assembly Language Development System	$1495
17XXA-202 FORTRAN Development System	1495
17XXA-203 Compiled BASIC Development System	490
17XXA-205 Extended BASIC Development System	490
17XXA-912 Non-ANSI C Development System	1995
17XXA-913 Non-ANSI C Compiler	1495

Application Software

Item	Price
17XXA-900 Binder	$30
17XXA-901 Gabby	195
17XXA-902 Touchscreen Toolbox	295
17XXA-903 Compiled MenuBASIC	295
17XXA-905 Extended MenuBASIC	295
17XXA-907 TransPort—>PC	450
S1703 Compiled MenuBASIC Development Package	1900
S1705 Extended MenuBASIC Development Package	1900

1760A & 1761A



1761A

1761A & 1761A Disk Drive Systems

- Compatible with IEEE-488 bus controllers
- Software supported for Fluke 1722A and 1752A Instrument Controllers
- 400K bytes of on-line capacity (1760A)
- 800K bytes of on-line capacity (1761A)
- Low EMI and RFI emissions, designed for lab environments
- Rack mountable
- Automatic self-test
- Double-density, double-sided format

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage for IEEE-488 bus systems. Rack mountable and supported with software for 1700 Series Instrument Controllers, you will find them easy to install and use. Installation is a matter of mounting and connecting the IEEE-488 bus cable. When used with a Fluke 1722A Instrument Controller or the 1752A Data Acquisition System, you will not need to be concerned with events and protocol on the IEEE-488 bus: available software for the Controllers allows either disk drive to be treated by application programs as if it were simply an additional drive installed in the controller.

Support software available for the 1722A Instrument Controller and 1752A Data Acquisition System is provided with the controller.

Specifications

Technical Specifications

Access Time: 505 ms, average
Transfer Rate: 50K bytes per second, burst; 12K bytes per second, average, with typical sector interleave
On-Line Capacity: 400K bytes with 1760A, 800K bytes with 1761A
Track Density: 48 tracks per inch
Speed: 300 revolutions per minute
Recording Format: 512 bytes per sector, 10 sectors per track, and 40 tracks per side (80 total). Double-density encoding
Disk: Fluke-qualified industry-standard 5.25 inch, certified double-density, 40 tracks, both sides
Disk Life: More than 3 x 106 revolutions with head contact, per track
Error Rates: 1 bit per 109, recoverable; 1 bit per 1012, non-recoverable

General Specifications

Signal Emissions: FCC Part 15, Subpart J, Class A; VDE 0871, Class B; CISPR 11-1975
Temperature: 10°C to 40°C, operating; -10°C to 60°C, non-operating
Relative Humidity: 20% to 90% from 10°C to 30°C, 20% to 80% from 30°C to 40°C, operating; 5% to 95%, non-operating
Power: 90V to 110V ac, 108V to 132V ac, 198V to 242V ac, or 216V to 264V ac, selectable, 47 to 63 Hz. 55W for 1760A, operating; 70W for 1761A, operating
Size: 13.3 cm H x 43.2 cm W x 39.6 cm D (5.25 in x 17.0 in x 15.6 in), both models
Weight: 1760A is 7.7 kg (17 lb), 1761A is 9.1 kg (20 lb)

Ordering Information

Models

January 1989 prices

1760A Disk Drive System	$1950
1761A Dual Disk Drive System	2950

Accessories (Also see page 485)

Y1706 Double-Sided Blank Disks (pkg. of 10)	60
Y1790 Rack Mount Kit w/24" Slides	195
Y1794 Rack Mount Kit w/18" Slides	175
Y8021 1m IEEE-488 Cable	130
Y8022 2m IEEE-488 Cable	145
Y8023 4m IEEE-488 Cable	155

Service & Support

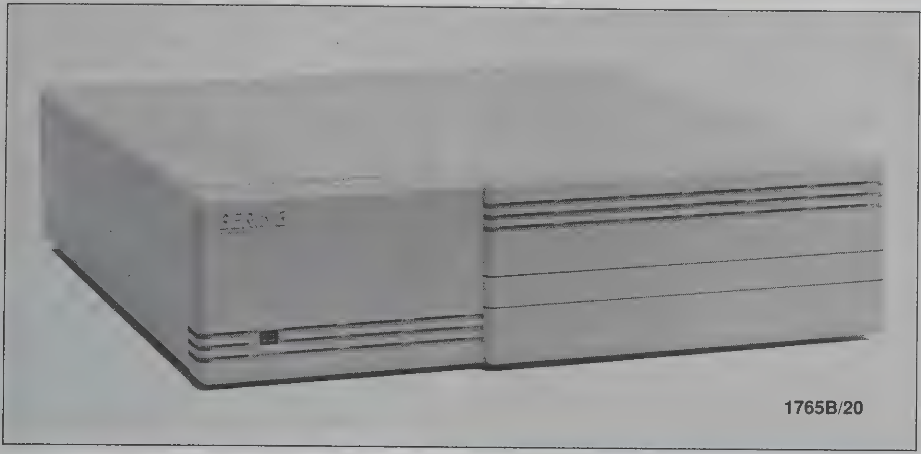
Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1760A Repair (w/calibration)	132
SC1-1761A Repair (w/calibration)	144

1765B/20


1765B/20

Winchester Disk Drive Systems

- GPIB/IEEE-488 commands transparent to user
- Average data transfer rate over IEEE-488 bus: 30K bytes/sec
- Complete self-test capability
- Rack mountable

The 1765B Series of Winchester disk drives provides high-capacity hard disk file storage for the Fluke 1722A Instrument Controller and 1752A Data Acquisition System. Both models provide for easy connection to the Controller or Data Acquisition System through a standard IEEE-488 interface. Both models are also rack-mountable. The 1765B Series is supplied to Fluke by a major disk drive subsystem manufacturer.

When used with a Fluke 1722A or 1752A, accommodating the 1765B Series is a snap. After connecting the 1765B to an IEEE-488 port of the controller or data acquisition system, you will have 20 megabytes of on-line storage.

When used with a Fluke 1722A Instrument Controller or 1752A Data Acquisition System, you will not need to be concerned with commands to the drive over the IEEE-488 bus. The system software created by the FDOS system generation program allows the Winchester drive to be treated by applications programs as if it were simply an additional drive installed within the mainframe.

Model Number 1765B/	Capacity M Bytes	No. of Users	Storage/ User M Bytes	Max Dis. to Contr.
20	20	1	20	14m
20M	20	3	5 + 5 Shared	20m*

** At least one 1722A or 1752A connected to the 1765B/20M must be located within 4m of the drive.*

1765B/20 20M-Byte Winchester Disk Drive

The Fluke model 1765B/20 is divided into eight logical devices of 2.5M bytes each. These logical devices are addressed as WD0: through WD7:.

1765B/20M Multi-User 20M-Byte Winchester Disk Drive

The 1765B/20M is a multi-user version of the 1765B/20. It has the capability of supporting up to three 1722As or 1752As. Each user has access to 5M bytes of Winchester disk storage. The other 5M is shared among all of the users connected to the system. The shared space can be used to transfer files between controllers, or to store files which are needed by more than one user connected to the system. 1722As or 1752As connected to the 1765B/20M can be located up to 20m away from the drive (one controller or data acquisition system must be located within 4m of the 1765B/20M).

Specifications

Maximum Sustained Transfer Rate: 30K bytes/second
On-line Capacity: 20M bytes divided into eight logical devices of 2.5M bytes each
Track Density: 588 tracks per inch
Rotational Speed: 3600 rpm
Recording Format: 256 bytes per sector, 34 sectors per track
Error Rates: Head read errors — 1 per 1012 reads
Temperature: 10°C to 40°C, operating; 40°C to 60°C, non-operating
Humidity: 20% to 80%, operating; 5% to 95%, non-operating
Shock: 10.0g
Vibration: 0.5g
Elevation: 0 to 4572m (0 to 15,000 ft), operating; -304 to 15,240m (-1000 to 50,000 ft), non-operating
Power: Selectable: 90 to 132V ac, 198 to 264V ac. 47 Hz-63 Hz. 1.1 amp @ 120V ac, 0.6 amp @ 240V ac
Weight: 10.58 kg (23.5 lb)
Size: 107mm H x 394mm W x 446mm D (4.2 in H x 115.5 in W x 115.5 in D)

Ordering Information

Models
January 1989 prices

1765B/20 20M-Byte Winchester Disk Drive	$3295
1765B/20M 20M Multi-User Winchester Disk Drive	on req

Accessories (Also see page 485)

Y1765B Rack Mount Kit	550
Y1765M 16m IEEE-488 Cable*	on req

**This IEEE cable only works with the 1765B/20M*

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1765B Repair (w/calibration)	265

PM 2240

GPIB
IEEE-488

NEW

PM 2240 TestTeam

- Fast, simple program generation for GPIB/IEEE-488 instrumentation systems
- Easy to use, menu-oriented operation with pull-down menus and pop-up windows
- Extensive instrument library allows GPIB/IEEE-488 programming by selecting parameters on instrument panels
- Built-in graphics and analysis functions for simple presentation of measurement data
- Powerful debugging tools for error-free programs
- Available for IBM PC's or PS/2

PM 2240 TestTeam provides GPIB/IEEE-488* programmers with a complete, easy to use environment for the generation, interactive use and execution of application programs in QuickBASIC™ or C. It combines Fluke and Philips instrument libraries with the National Instruments Labwindows programming environment.

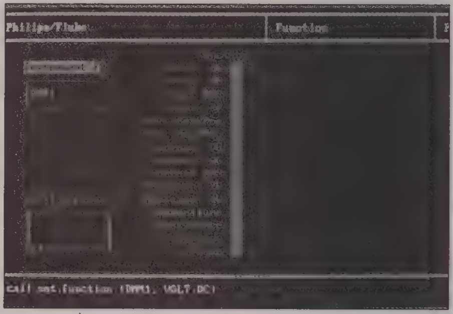
Fast, Simple Program Generation

The TestTeam programming environment greatly reduces programming time with its simple and powerful editor and large number of standard functions and libraries. These facilities are readily available via pull-down menus and pop-up windows. A programmer can create a program in either QuickBASIC or C using the editor, and insert calls to graphics, analysis and instrument control functions by filling in function panels. An online context-sensitive help facility guides the novice through parameter entry in these panels.

Complete Instrument Control

In the instrument library, support is provided for numerous Philips and Fluke instruments in the form of specific instrument drivers. A programmer controls an instrument by simply entering parameters in a function panel. The generated function call can be inserted in the application program, at the current location of the cursor, or executed immediately. The generated function call is clear and self-documenting, considerably reducing the time to interpret previously written programs. Instrument drivers include thorough error checking ensuring reliable measurement results. With so many ready made, complete instrument drivers, developers and users need no knowledge concerning GPIB protocols for the individual system instruments.

As well as the Fluke and Philips instrument drivers, TestTeam includes a number of drivers for instruments from other suppliers. The user can also write his own drivers, or control the GPIB bus at bus level using the TestTeam commands. This allows tailoring of the application program with no loss of flexibility.



```
call set_function (DMM1, VOLT_DC)
```

The above function panel for a Philips or Fluke digital multimeter, here with the instrument identity DMM1, allows direct selection of the desired measuring functions. The function call(s) corresponding to the selected instruments functions are automatically generated by TestTeam and displayed under the function panel. These function calls can then be executed with the "Go!" command or be inserted in the application program at the present location of the cursor.

Ready to Use Graphics and Analysis Libraries

Libraries for graphical presentation and analysis of measurement data provide the programmer with a number of standard functions. Drawing a graph, calculating a standard deviation is now simply a matter of filling in the blanks of a function panel. For more advanced analysis functions, like FFT, integration, differentiation, correlation, convolution, RMS and many more, there is the optional PM 2241 Advanced Analysis Package.

Reduced Debugging Time

As well as providing a clear and convenient environment for writing test prgrams, TestTeam allows fast, effective program testing, with built-in facilities for syntax checking and interactive debugging. Sections of the program can be executed step by step or tested separately. Breakpoints can be inserted and program variables can be examined and changed to speed debugging.

Programming Environment Tailored for GPIB

TestTeam offers three windows for program editing and testing. The program window offers a full-screen editor, which supports fast and efficient program modification. The interactive window permits the user to execute and debug a section of his application program, and the standard Input/Output window provides an area for

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The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

input and output during execution of an application program. Any two of these windows can be displayed simultaneously.

Programs created with TestTeam can not only be executed within the TestTeam environment, but can be saved as QuickBASIC or C files which can be compiled for execution in a different environment. The only option required is the instrument library for the selected programming language (PM 2231 for Microsoft C and PM 2233, for QuickBASIC see page 376). As a new and simple to use tool for GPIB program development, TestTeam saves time and is the most cost effective solution.

System Requirements

IBM PC/XT/AT or compatible, or IBM PS/2 Model 30 with MSDOS:

- Minimum 640 kbytes of memory, a floppy and hard disk drive
- IBM CGA, EGA or VGA, Hercules monochrome or compatible graphics adapters to execute graphics functions
- Philips PM 2201/99 or National Instruments PC-IIA/PC-IIB GPIB interface cards (see page 379)

IBM PS/2 Model 50, 60, 80 with MSDOS:

- Minimum 640 kbytes of memory, a floppy and hard disk drive
- Philips PM 2202/99 or National Instruments MC-GPIB interface cards (see page 379)

Ordering Information

Models

January 1989 prices

PM 2240/001 TestTeam	$925
PM 2201/99 GPIB interface for PC	399
PM 2202/99 GPIB interface for PS/2	499

Options

PM 2241/001 TestTeam Advanced Analysis Library (optional)	$995

Note: The above configurations meet North American power requirements. For other power options, see page 491.

The following are registered trademarks:
Labwindow: National Instruments
PC/XT/AT, PS/2: IBM Corporation
Hercules: Hercules Computer Technology Inc.
Microsoft, MS-DOS, QuickBASIC: Microsoft Corporation

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

PM 2230 Series

NEW

PM 2230 Series

PM 2230 Series Instrument Drivers

- Automatic configuration utility for fast system configuration
- High level instrument commands ease programming and debugging
- Extensive built-in error checking and reporting
- Includes easy to use GPIB/IEEE-488 drivers
- Support for BASICA/GWBASIC, QuickBASIC, Pascal and C
- Available for IBM PC's and PS/2

GPIB/IEEE-488* system programming is simplified by the Philips Instrument Drivers for the IBM PC or PS/2 computers equipped with Philips GPIB interfaces (see page 362). These drivers cover a range of specific Fluke and Philips GPIB instruments, including multimeters, frequency generators and synthesizers, digital storage oscilloscopes (DSOs), counters and switch units. Included in the instrument driver packages are GPIB procedures to program instruments not supported with specific drivers.

Auto-Configuration Utility

The auto-configuration utility automatically determines the GPIB system configuration, including instrument addresses and type, and assigns a user defined name to each instrument. After running this utility, the user can write his application program with the knowledge that the system is correctly configured.

Fast and Simple Development and Debugging of programs

High-level instrument commands, which are just as simple as using the front panel of the instrument, free the user from the task of learning the different GPIB mnemonics of each instrument and the details of GPIB control. This allows the user to concentrate on the application itself instead of the subtleties of GPIB programming.

Instrument drivers enhance the readability of the program. This results in code that is self-documenting and very easy to understand. Hence the use of instrument drives reduces time spent on program debugging and maintenance.

Instrument drivers also automatically check command validity. For example out-of-range parameters are trapped, resulting in error-free instrument operation.

```
1400 'Send the generator a new frequency between 50 Hz
1410 'and 1 kHz and have the counter take a reading.
1420 'Perform this action 20 times.
1430   FOR FREQ = 50 TO 1000 STEP 50
1440     CALL SET.FREQUENCY(GNR1, FREQ)
1450     CALL MEASURE(CNT1, VALUE)
1460     PRINT "Frequency = "; VALUE; " Hz"
1470   NEXT FREQ
```

"An example of code written using Instrument Drivers."

Supported Languages

Instrument drivers are available for the languages BASICA/GWBASIC (PM 2230), Microsoft C (PM 2231), Microsoft Pascal (PM 2232) and QuickBASIC (PM 2233). Instrument drivers for DSOs , supporting all languages, are available in a separate package, the PM 2235.

Supported Instruments

For PM 2230/31/32/33:
- Multimeters: Philips PM 2525/33/34, Fluke 8840/42
- Generators: Philips PM 5191/92/93, Fluke 6060/62**
- Counters: Philips PM 6652/52C/54/54C/65/66/69
- Switches: Philips PM 2120/21/22/23/24/2

For PM 2235:
- DSOs: PM 3320A/50/65

Philips continuously extends the range of instruments supported by their software packages.

System Requirements

IBM PC/XT/AT or 100% compatible and PS/2 Model 30 with MSDOS:
- Minimum 512 kbytes memory, a floppy and a hard disk drive
- Philips PM 2201/99 or National Instruments PC-IIA/IIB GPIB interfaces (see page 379)

IBM PS/2 model 50/60/80 with MSDOS:
- Minimum 512 kbytes memory, a floppy and a hard disk drive
- Philips PM 2202/99 or National Instruments MC-GPIB interface cards (see page 379)

For PM 2230: BASICA/GWBASIC rel. 2.02 or higher. PM 2231: Microsoft C rel. 4.00 or higher. PM 2232: Microsoft Pascal rel. 3.32 or higher. PM 2233: Microsoft QuickBASIC rel. 4.0

Ordering Information

Models

	January 1989 prices
PM 2230/001 Instrument drivers for BASICA/GWBASIC	$590
PM 2231/001 Instrument drivers for C	590
PM 2232/001 Instrument drivers for Pascal	590
PM 2233/001 Instrument drivers for QuickBASIC	590
PM 2235/001 Oscilloscope Instrument Drivers***	495
PM 2201/99 GPIB interface for PC	399
PM 2202/99 GPIB interface for PS/2	499

The following are registered trademarks:
PC/XT/AT, PS/2: IBM Corp.
Microsoft, MS-DOS, QuickBASIC: Microsoft Corp.

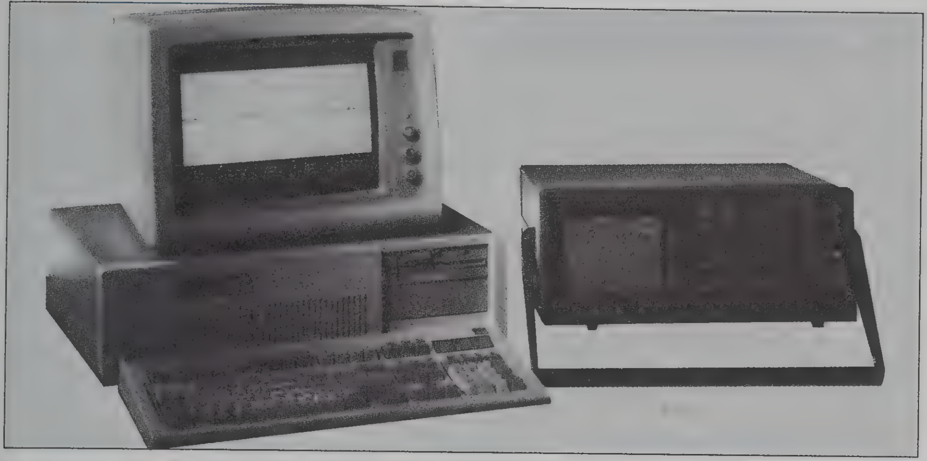
**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

***The Fluke 6060 & 6062 will be supported in Feb. 1989.*

****For use with the PM 2230, PM 2231, PM 2232 & PM 2233. Requires one of the above instrument driven packages.*

PM 2260

NEW

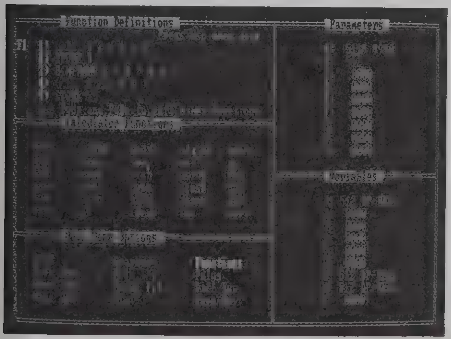


PM 2260 Oscilloscope Signal Processing

- Extensive waveform analysis and display functions all accessible via menus and function keys
- Menu driven data communication for Philips DSOs
- Data capture and analysis of waveforms
- Fast data transfer via GPIB/IEEE-488
- On-line help facility
- Available for IBM PCs

The PM 2260 Oscilloscope Signal Processing package is a complete software package for the analysis of measurement data from Philips Digital Storage Oscilloscopes (DSOs) on PCs. It is a combination of DSO drivers tailored for data transfer from the DSO to the PC and the ASYSTANT-GPIB™ software package.

ASYSTANT-GPIB is menu structured and offers an unprecedented range of mathematical, waveform analysis and processing, statistics, text editing, graphic functions and GPIB/IEEE-488* programming capabilities. An on-line help facility makes this powerful ready-to-run package very easy to use and increases the application range of Philips DSOs.

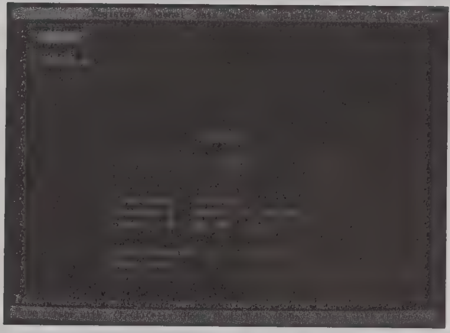


Data Transfer

Data can be transferred from the DSO to the PC via two methods. The first method uses menu-oriented instrument drivers for Philips DSOs which allow a user to simply select parameters like DSO channel, DSO register and number of data points via a menu. Channel, register, number of data points and name of destination file are the most important parameters which have to be entered in the data transfer menu. The result is a file on the PC with all the available and scaled information on the captured waveform. With the Philips DSO drivers no programming skill or effort is required.

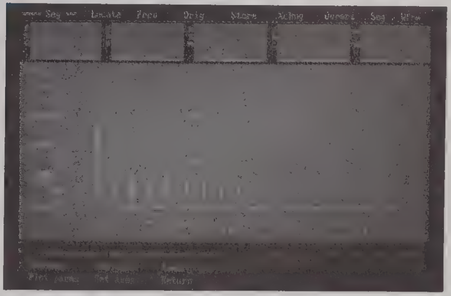
The second method involves using the built-in GPIB programming power of ASYSTANT-GPIB. ASYSTANT-GPIB allows a user to program the PC to capture a waveform from the DSO, scale the waveform and perform analysis all in real time. The user can create up to 30 different GPIB programs, which can call each other, enabling the user to build sophisticated GPIB programs.

Both of the two data transfer methods provide the user with support for the following Philips DSOs: PM 3308, PM 3320/20A, PM 3335, PM 3340, PM 3350 and PM 3365. The Philips DSO drivers provide support by including menu-oriented instrument drivers for each of the supported DSOs. Support for the GPIB programming power of ASYSTANT-GPIB is provided by including GPIB programs for each DSO showing how to capture and scale a waveform from the DSO.



Mathematics

The PM 2260 includes a full function array-based scientific calculator supporting single and double precision reals, integers and complex numbers. The many available functions include arithmetic functions, conversions (complex/real imaginary, complex/polar, polar/cartesian, cartesian/sperical), array operations (generating, editing, rotating, plus many more), and matrix and waveform analysis operations (FFT, inverse FFT, power spectrum, smooth, integration, differentiation, averaging, standard deviation, plus many more).



Waveform Processing

The waveform processor offers an extensive range of functions to interactively analyze signals captured with the DSO. On-screen graphic cursors isolate waveform segments and "visual" memories hold intermediate results. The processing functions include smoothing, enveloping, area under the curve calculations, power spectra, plus many more.

Graphics

On-screen graphical representation is vital for thorough data analysis. The PM 2260 offers a large number of graphic functions enabling the user to tailor the data representation to the format most suited to his application. Graphic functions include multiple windows, auto plotting

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

and scaling, linear, log and semi-log plots, axonometric and contour plots, labeling in eight directions plus many more.

. . .and More

Other standard PM 2260 functions include statistics, differential equations and polynomials. All signals and values can be stored on the PC, or output to a printer or plotter. The PM 2260 includes ready-to-run software drivers for popular printers with a centronic interfaces and HPGL plotters with serial interfaces.

System Requirements

IBM PC/XT/AT or 100% compatible and PS/2 model 30:

- Minimum 640 kbytes memory.
- Floppy disk & hard disk
- 8087, 80287 or 80387 math coprocessor
- Philips PM 2201/99 (see page 379) or National Instruments PC-IIA/IIB GPIB Interface Card

Ordering Information

Models

January 1989 prices

PM 2260/002 Oscilloscope Signal Processing software package	$795
PM 2201/99 GPIB Interface for PCs	399

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Notes:

The above configurations meet North American power requirements. For other power options, see page 491.

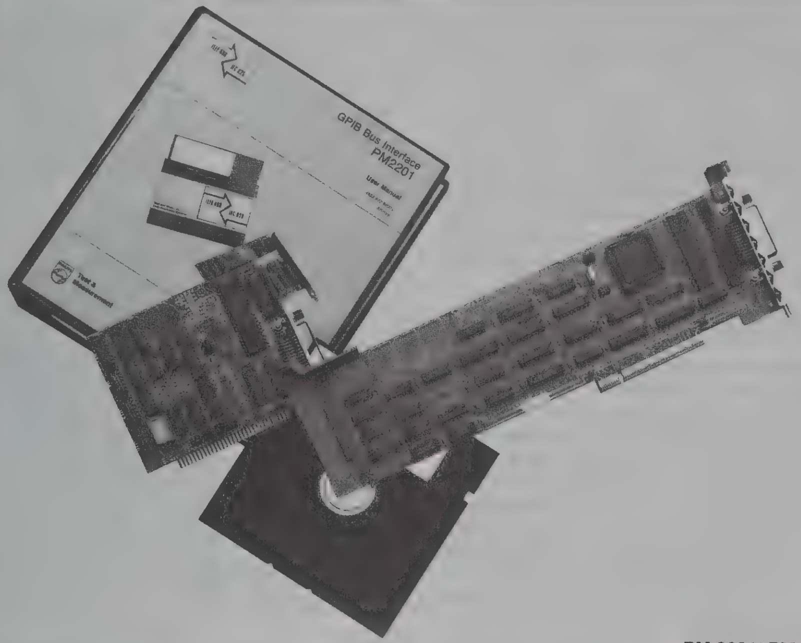
PC/XT/AT, PS/2 is a registered trademark of IBM Corporation

MS-DOS is a registered trademark of Microsoft Corporation

ASYSTANT-GPIB: is a registered trademark of Asyst Software Technologies

PM 2201/PM 2202

NEW



PM 2201/ PM 2202

PM 2201 & PM 2202 GPIB/IEEE-488 Interfaces for PC and PS/2

- Turns IBM PC's and PS/2's into versatile GPIB/IEEE-488 controllers
- Includes easy to use GPIB/IEEE-488 drivers for BASICA, Pascal and C
- Supported by PM 2230 Series, PM 2240 and PM 2260 software packages for easy programming of GPIB/IEEE-488 instruments
- Supported by a large range of software packages from other suppliers

Hardware

The PM 2202 contains the extremely advanced MC-GPIB interface from National Instruments, for the IBM Personal System/2 equipped with Micro Channel plug-in slots. The PM 2201 contains the widely used PC-IIA GPIB interface from National Instruments for the IBM PC/XT/AT and 100% compatibles. Installing the cards is very simple and with the PM 2202, all settings are software programmable using the PS/2 Programmable Option Set facility.

Software

PM 2201 and PM 2202 include a set of GPIB/IEEE-488* drivers for writing application programs in GWBASIC/BASICA, Microsoft C and Microsoft Pascal. These GPIB routines include all commonly used functions like bus initialization, sending commands, sending and receiving messages, remote and local instrument setting, serial polling, time-out setting and others. Error checking is included in all drivers to enhance program reliability.

PM 2201 and PM 2202 are software compatible, so that a program developed on a PC with the PM 2201 will also run on a PS/2 equipped with a PM 2202 and vice versa. This greatly extends the use and life cycle of application programs.

System Requirements

For PM 2201: IBM PC/XT/AT or 100% compatible or PS/2 Model 30:

- Minimum 256 kbytes of memory, a floppy and hard disk drive
- GWBASIC/BASICA rel. 2.02 and higher or Microsoft Pascal rel. 3.32 and higher or Microsoft C rel. 4.00 and higher

For PM 2202: IBM PS/2 Model 50/60/80:

- Minimum 256 kbytes of memory, a floppy and hard disk drive
- GWBASIC/BASICA rel. 2.02 and higher or Microsoft Pascal rel. 3.32 or Microsoft C rel 4.00 and higher.

Ordering Information

Models	January 1989 prices
PM 2201/02 GPIB Interface for PC including GPIB Driver Software	$595
PM 2201/52 GPIB Drivers Software for PC with PM 2201/99 or National Instruments PC-2A/2B	260
PM 2201/99 GPIB Interface for PC, without software	399
PM 2202/01 MC-GPIB Interface for PS/2 including MC-GPIB Driver Software	695
PM 2202/51 MC-GPIB Drivers for PS/2 with PM 2202/99 or National Instruments MC-GPIB	260
PM 2202/99 MC-GPIB Interface for PS/2, without software	499

Service & Support

Warranty

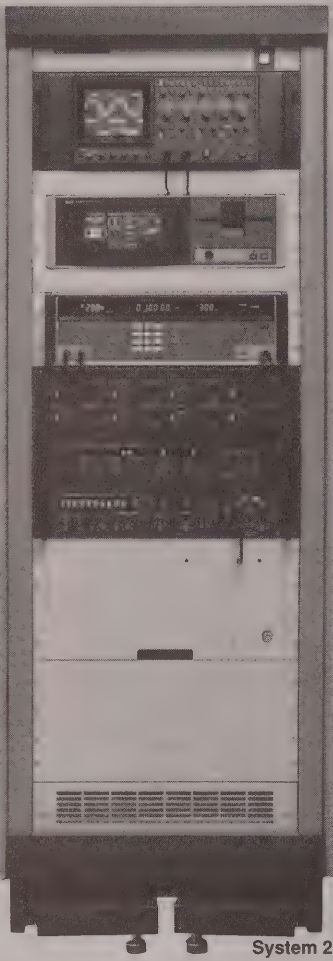
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see page 491.

The following are registered trademarks:
PC/XT/AT, PS/2: IBM Corporation
Hercules: Hercules Computer Technology Inc.
Microsoft, MS-DOS, QuickBASIC: Microsoft Corporation

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

System 21



System 21

System 21 Modular GPIB Switching System

For small/medium-size instrumentation systems

Applications areas include:

- Research & development labs
- Quality control
- Small-scale production
- Education

A Simple System, Any Way You Stack It

Until now, automatic GPIB/IEEE-488* switching systems came in two varieties: big, but expensive, and small, but limited.

Now the Philips System 21 fills the gap with an expandable modular system that fits both your projects and your budget. And it fits your benchtop too.

System 21 is a complete family of fifteen stackable intelligent modules, each suited to a special function, all tied to a single GPIB address, all completely computer controlled.

It's so easy to use that you'll cut learning time dramatically compared to most mainframe systems. And it's so easy to change that you can perform nearly any small or midrange automated tests with ease.

Buy Only the Functions You Need

Perhaps the best thing about System 21 is that you need not buy a complete system to get the functions you want.

You can begin with just two units – a master and slave – and then expand as your needs grow. Start with, say, the master unit and a universal switch, then later add a digital input/output unit, then an 18 GHz switch, then maybe a user-configurable module for those special functions that you need from time to time.

You decide what you need, and buy only when you need it.

Easy to Start. Easy to Expand

The cost to begin building your system is naturally far less than for mainframe switching systems. So you get both the flexibility of mainframes and the affordability and convenience of off-the-shelf components.

And the cost to expand your system is lower still. You needn't break your budget to add functions.

On the Bench

System 21 is a great tool for prototype testing and benchtop experiments of all kinds.

Working with even a single multimeter and PC, System 21 brings affordable, verstile automatic switching to research and development departments and engineering staffs. Without the needless expense of mainframe switching systems, without the hassle of do-it-yourself switches.

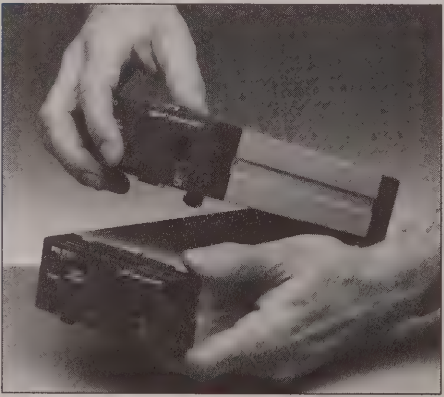


Figure 1

Or in the Rack

In production environments System 21 can be rack mounted for larger instrumentation systems, handling switching and I/O functions too small to warrant expensive mainframe equipment.

Also, System 21's modular design and easy software control allow quick reconfiguration for a host of different tasks. Production testing has never been so flexible.

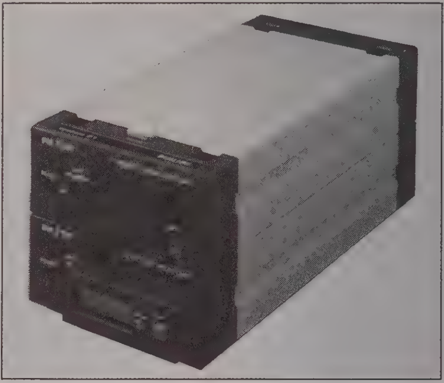


Figure 2

The System Behind the System

System 21 consists of a master module and up to fifty slaves, all tied to a single GPIB address.

The modules snap together top and bottom for easy connection, but they can be cabled as well.

Simple commands control everything. Each module works independently, and each can store commands, which can be triggered later by the controller.

That means simpler programming, and far less coding of repetitive tasks.

The following three command strings, written on a Fluke 1722A Instrument Controller

```
PRINT @7, “AID 203; CLOSE 4-6, OPEN 3”;
PRINT @7, “AID 201; MODE 00, OPEN 5, CLOSE 1”;
PRINT @7, “AID 301; STATUS ?”
```

are command strings to System 21 at GPIB address 7 with messages for:

PM 2120 with System 21 address 3 to CLOSE contacts 4, 5 and 6 and OPEN contact 3.

PM 2120 with System 21 address 1 to go to MODE 00 and OPEN contact 5 and CLOSE contact 1.

PM 2131 with System 21 address 1 to send STATUS information

Most modules have multiple operating modes, too. So you can make your system even more flexible by configuring each module several ways.

The Universal Switch, for instance, can be configured three ways; for twenty individual on/off switches, ten break-before-make switches or

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

ten make-before-break switches. Similarly, digital input/output modules can be used in either direct or latching modes.

And all modules feature multiple execution modes, including a scan mode to activate individual switch inputs in sequence with minimum coding – another way to simplify your work.

Simple Yet Flexible

GPIB testing has never been so easy. You control all of System 21 through on master unit, using one controller and easy-to-use software. Intelligence is distributed throughout the system for easy programming. And you can reconfigure in a thousand ways.

It's one system you can't beat.

Specifications

Mechanical Construction: All units are housed in a separate box. Mechanical interconnection to the master and other units is by means of a bolt construction in the feet of each unit.
Dimensions: 105 mm W x 44.4 mm H x 226 mm L (4.3 in W x 1.7 in H x 8.9 in L) (excluding connectors and feet)
Height of Feet: 11 mm (0.43 in)
Display Module: The optional PM 2190 Display Module can be plugged into the front panel socket of each unit, to provide status information.
Terminal Connector: One or more terminal connectors are provided on the rear panel of each unit

Environmental Data

Operating Temperature: 0 + 55°C
Storage Temperature: -40 + 75°C
Humidity 80%: (0 + 55°C)
Dewpoint: 25°

Module Specifications

PM 2101 Master Unit

The PM 2101 Master Unit provides the power supply to the complete system and handles communication between the GPIB interface bus and the System 21 internal bus.

Bus Communication

Communication between the GPIB bus and the internal bus is fully transparent. Messages addressed to the Slave Units are not influenced by the Master Unit.

Power Supply

Power: 110, 120, 220 or 240 VAC ±10%, 50 or 60 Hz
Power Consumption: 16 VA max
Safety: Class II acc. to IEC 348
Secondary Power Supply to Slave Units: 7.5V (at full load) to 15V (unloaded)
Maximum Current Load: 750 mA (If higher currents are needed, additional PM 2198 power supply units can be used in parallel).

System Control Functions

Control functions of the Master Unit include identification, synchronization and service request handling.

Identification

On request, the Master Unit returns with:
a. Type number and version of the Master Unit
b. List of connected Slave Units

Trigger Facilities

Trigger commands from the GPIB bus can be distributed at choice to:

- Individual units
- All units with identical type numbers
- All units

If required, these trigger commands can be delayed until the ready line is "true".

Reading the Ready Line

On request, the Master Unit returns with the status of the ready line.

Resetting the System

The system can be reset to power-on conditions via the GPIB bus, or by means of a (protected) reset button on the Master Unit.

Service Request Handling

The Master Unit includes masking facilities to select from several reasons for service request messages. These include

- Power failure or illegal code
- Addressed unit is not present or has synchronization error
- A unit has data available, has reached end of block or has a functional warning
- Changes in ready or trigger line

The Master Unit returns with detailed information on the source of the service request call by means of a polling procedure after a service request is received.

GPIB Interface Data

Interface functions:

Description	Function	Capability
Source handshake	SH1	Complete
Accepter handshake	AH1	Complete
Talker function	T6	No talk only
Listener function	L4	No listen only
Service request	SR1	Complete
Remote/Local	RLO	No local control
Device clear	DC1	Complete
Device trigger	DC1	Complete

Address setting: 10 to 19

Accepted input data:

- Control data for Slave Units, Master Unit and interface
- General multiline commands; DCL, SPE, SPD, GET, SDC

Output Data: Functional messages, status and error messages of the units.
Separators: Record separators can be software programmed to one or two characters. At power-on, record and block separator are "NL".
Service Request: The following reasons for a service request can be enabled or disabled under software control: illegal header or body, System 21 request.
Connector: Standard GPIB connector.

PM 2120 Universal Switch

The PM 2120 Universal Switch offers 20 switches grouped in 10 pairs, each with a common contact. Depending on the switching mode setting, the switches can be used as:

- 20 individual on/off switches with one common contact per pair; or
- 10 single pole double throw (SPDT) break-before-make or make-before-break switches.

The contacts are high quality reed relays able to handle 200 mA, 30V and frequencies up to 100 kHz.

Technical Specifications

Configuration: 10 elements of 2 switches with a common output
Operating Modes
Mode 0: 20 individual switches (with common output per pair) for multiplexing or matrix switching
Mode 1: 10 SPDT make-before-break
Mode 2: 10 SPDT break-before-make
Max. Switching Voltage: 30V rms
Max. Switching Current: 200 mA
Max Switching Power: 10 VA (resistive load)
Max. Common Mode Voltage between Terminals or between Terminal and Ground: 30V rms AC or 40 VDC
Frequency Range: DC to 100 kHz
Series Resistance: <0.5Ω
Open Contact Resistance: $>10^9\Omega$
Isolation Resistance: $>10^9\Omega$
Crosstalk Isolation: 60 dB at 100 kHz, $R_0=50\Omega$
Switching Time Individual Relay: <10 ms, until last relay has settled in any mode: <25 ms, break-before-make or make-before-break; 10 to 20 ms
Terminal: 37-pin female D-type connector
Display Module: The optional RM 2190 Display Module shows

- Switching mode, synchronization mode and ready status
- Settings of individual switches

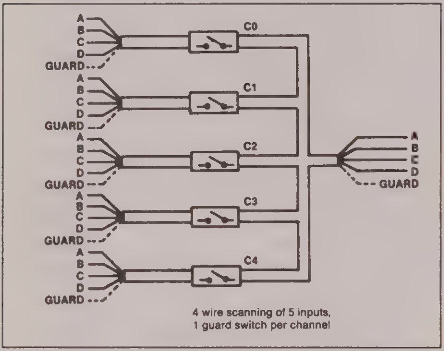
Current Consumption for System Supply: 25 mA (all switches open) to 125 mA (all switches closed)

PM 2121 Low-Level Switch

The PM 2121 Low-Level Switch offers 5 switches (each 4 wires + guard) at the input, and mode-switching at the output. Depending on the switching mode, the switches can be used for scanning of:

- 20 channels of 1 wire + guard (guard in common for 4 channels)
- 10 channels of 2 wires + guard (guard in common for 2 channels)
- 5 channels of 4 wires + guard

Switch contacts are matched to the special requirments of switching at low signal levels. The thermovoltage is <3 µV



4 wire scanning of 5 inputs,
1 guard switch per channel

Technical Specifications

Configuration: 5 elements of 4 contacts + guard at the input and a mode switching unit at the output

Operating Modes

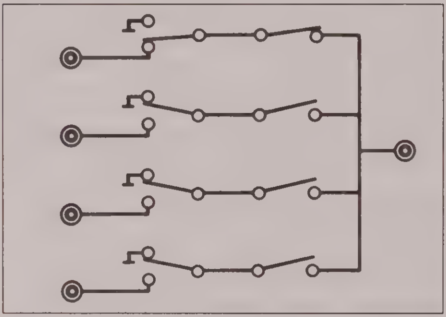
Mode 1: 1 wire (+ guard) scanning of 20 inputs
Mode 2: 2 wire (+ guard) scanning of 20 inputs
Mode 4: 4 wire (+ guard) scanning of 5 inputs. A common guard for 4 contacts is used in all modes
Max. Switching Voltage: 24V rms
Max. Switching Current: 500 mArms
Max. Switching Power: 12 VA (up to 1 MHz)
Max. Common Mode Voltage Terminals or between Terminal and Ground: 24V rms AC or DC
Frequency Range: DC to 1 MHz
Series Resistance: <1Ω
Open Contact Resistance: >10^9Ω
Isolation Resistance: >10^9Ω
Crosstalk Isolation: >90 dB (50/60 Hz); >40 dB (1MHz)
Switching Time Individual Relay: <10 ms, until last relay has settled in any mode: <25 ms
Order of Contact Closure and Opening: Input guard, input contacts, output guard, output contacts and inverted
Terminal: 37-pin female D-type connector
Display Module: The optional PM 2190 Display Module shows

- Switching mode, synchronization mode and ready status
- Selected channel

Current Consumption from System Supply: Typcial 25 mA, max. 50 mA

PM 2122 50Ω Coaxial Switch

The PM 2122 50Ω Coaxial Switch Unit offers facilities for the selection of one of four inputs to the output.
The unit is suitable for switching VHF signals up to 500 MHz and 24 V rms. Matching impedance is 50Ω



Technical Specifications

Switch Configuration: 4 single pole double throw switches selecting 1 of 4 inputs
Operating Mode: Fixed
Matching Impedance: 50Ω (open inputs are not terminated)
Max. Switching Voltage: 24V rms AC
Max. Switching Current: 250 mA rms
Max. Switching Power: 3 VA (50Ω load)
Max. Common Mode Voltage between Terminals or between Terminal Ground: 24V rms AC or DC
Frequency Range: DC to 500 MHz
VSWR: <1.2 at 100 MHz; <1.5 at 500 MHz
Series Resistance: <1Ω
Open Contact Resistance: >10^8Ω
Isolation Resistance: >10^8Ω
Crosstalk Isolation: >50 dB at 100 MHz, >25 dB at 500 MHz
Switching Time Individual Relay: <10 ms, until last relay has settled: <25 ms
Terminals: 50Ω BNC connectors
Display Module: The optional PM 2190 Display Module shows

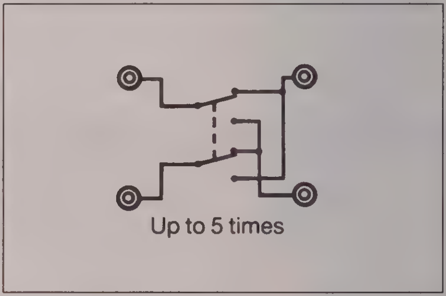
- Synchronization mode and ready status
- Selected channel

Current Consumption from System Supply: Typical 35 mA, max. 60 mA

PM 2123 18 GHz Switch

The PM 2123 18 GHz Switch Unit provides facilities for driving up to five microwave switches, one of which can be mounted inside the PM 2123. Four others (or all five) can be connected via connectors.

As supplied, PM 2123 includes one switch mounted inside the unit. Additional switches can be ordered separately under part number PM 7551 (switch type as included with PM 2123) or PM 7550 (see separate specification).



Technical Specifications

Switch Configuration: 2 inputs and 2 outputs enabling straightforward or cross connection
Operating Mode: Fixed
Matching Inpedance: 50Ω
Max. Switching Power: 15W average, <1 kW peak
Frequency Range: DC to 18 GHz
VSWR: <1.1 at 1 GHz, <1.5 dB at 18 GHz
Isolation: >80 dB at 1 GHz, >60 dB at 18 GHz
Insertion Loss: <1.1 dB at 1 GHz, <1.5 dB at 18 GHz
Switching Time Individual Relay: <40 ms
Min. Time Between Successive Switch Operations: 500 ms
Terminals: 50Ω SMA jack
Display Module: The optional PM 2190 Display Module shows

- Synchronization mode and ready status
- Selected channel

Current Consumption From System Supply: Typical 35 mA, max. 60 mA
Specification of PM 7550 When Driven by PM 2123: Switch configuration. SPDT with 2 inputs.

PM 2124 High Current Switch

The PM 2124 High Current Switch offers 6 independently controlled bistable switches in groups of three connected to two terminals. It can switch AC power up to 2500 VA and DC up to 300W. The high current switch is for testing motors and other electro-mechanical devices, and the switches are provided with earth connections. They meet the IEC 348, Class 1 safety specifications.

Technical Specifications

Configuration: 6 independently controlled bistable switches in 2 groups of 3
Operating Mode: Fixed
Max Switching Voltage: 250 Vrms AC, 400 VDC
Max. Switching Current: 10A AC at up to 250V 10A DC at up to 30V 25A per terminal
Max. Switching Power: 2500 VA AC, 300W DC
Contact Resistance: 50 MΩ relays only 25 mΩ (including wiring and terminal)
Isolation Resistance: 2 MΩ
Cross Talk Isolation: Negligible up to 1 kHz
Inrush Current: 50A
Switching Time: Bistable relays switched in sequence - total switching time 50 ms + (n x 50 ms) for n contacts
Terminals: 2 x Amphenol series 97 terminals. Two corresponding plugs also supplied
Display Module: Optional PM 2190 shows position of relays.
Current Consumption From System Supply: Typically 25 mA

PM 2125 Probe Switch Driver

Where oscilloscope measurements have to be made at a number of points in an automatic GPIB system, the available instrument input channels often form a limitation. Now, with the PM 2125 Probe Switch Driver and PM 2195 Probe Switch, a single-channel instrument can accept up to four separate inputs, while the capacity of a four-channel oscilloscope can be increased to 16 inputs.

The PM 2125 Probe Switch Driver allows up to 4 PM 2195 Probe switches, for a total of 16 probes, to be connected to a GPIB system. Programming of the probe driver is made very simple by easy-to-interpret command strings. The probe switch driver is made very simple by easy-to-interpret command strings. The probe switch driver can operate in two modes: one for individual probe selection, and the other for parallel probe switching. The optional PM 2190 Display Module can show either the selected probes, the operating mode or the probe and switches that are not present in the system.

Technical Specifications

Operating Modes: 1 - individual probe selection. 2 - parallel switching of corresponding probes from 4 switches.
Contact Closure: Automatic closing of the 'ON' probe when a new probe is selected in the same probe switch unit
Switching Time: 50 ms
Read Back Facilities: Status of received commands: warning of illegal commands; warning of probe/switch selected but not present
Display Module: (optional PM 2190): Shows selected probes; operating mode; probes and switches not present
Current Consumption: 70 mA

PM 2195 Probe Switch

The PM 2195 Probe Switch provides an answer to problems which occur when waveforms are switched in typical GPIB systems. In general, switching waveforms before the signal is applied to the input probe causes load and interference problems, and switching between probe and oscilloscope input results in a significant degradation of bandwidth.

The PM 2195 Probe Switch consists of a 4-input selector switch and 4 attenuator probes. The switch is so compact that it can be plugged directly into the oscilloscope input socket and offers 4 probe inputs with individual adjustment facilities. Each probe can therefore be tuned for optimum response, so that a bandwidth of 400 MHz (3 dB) is ensured with an oscilloscope which has an input capacitance of less than 10 pF. As a result, only slight degradation of the bandwidth (5%) takes place for oscilloscope up to 300 MHz.

Technical Specifications

Input Probes

Number of Probes: 4
Attenuation Factor: 10 ±2%
Input Impedance: 10 MΩ/13 pF
Bandwidth: Including switch for scope with input capacitance <10 pF: DC to 400 MHz
Cable Length: 1.5 mP
Remote Probe Switch Required Output Load: 1MΩ//9 to 35 pF
Switch Control: PM 2125 probe switch driver (GPIB) or directly with 5V/12 mA supply

PM 2130 Digital I/O Unit

The PM 2130 Digital Input/Output Unit provides 8-bit input and output with optical isolation for signal levels from 0-5 to 0-30V. Outputs can be loaded up to 100 mA. The inputs can be used as latching input, and can set a warning flag when they match a reference pattern.

Technical Specifications

Configuration: 2 groups of 4-bit input and 1 group of 8-bit output with a common return line per group
Operating Modes
Mode 0: 8 input bits and 8 output bits
Mode 1: 8 latching input bits and 8 output bits
Latching Mode: In the latching mode a latch is set when the corresponding input is high for a period of >1 ms. The latches are reset by the RSL command.
Reference Facility: By setting a reference for the individual inputs to "dont' care", Low, High or changing state, a matching input or a change in input can be detected. The corresponding warning flag can be used to generate a service request message.
For Input/Output Details: See Table 1

Timing

Response Time on Setting Commands: <8 ms
Response Time on Read Commands: <8 ms
Minimum Pulse Width to set "match reference" Flag: 5 ms
Minimum Pulse Width to Set Latch: 0.5 ms
Terminal: 37-pin female D-type connector
Display Module: The optional Pm 2190 Display Module shows
- Synchronization mode and ready status
- Data sent to the output
- Logic states of the inputs

Current Consumption: <100 mA

PM 2131 Digital Input Unit

The PM 2131 Digital Input Unit provides 16-bit optically isloated input subdivided into 4 groups of 4 bits. Signal level is 0-5 to 0-30V. The inputs can be used as latching input. The inputs can be compared with preset reference to check on state or change of state.

Technical Specifications

Configuration: 4 groups of 4-bit input with optical isloation, and a common return line per group
Operating Modes
Mode 0: 16 input bits
Mode 1: 16 latching input bits
Latching Mode: In the latching mode a latch is set when the corresponding input is high for a period of <1 ms. The latches are reset by the RSL command.
Reference Facility: By setting a reference for the individual inputs to "dont' care", Low, High or changing state, a matching input or a change in input can be detected. The corresponding warning flag can be used to generate a service request message.
For Input/Output Details: See Table 1

Timing

Response Time on Setting Commands: <8 ms
Response Time on Read Commands: <8 ms
Minimum Pulse Width to set "match reference" Flag: 5 ms
Minimum Pulse Width to Set Latch: 0.5 ms
Terminal: 37-pin female D-type connector
Display Module: The optional Pm 2190 Display Module shows
- Operating mode, sychronization mode and ready status
- Logic states of the inputs

Current Consumption: <80 mA

PM 2132 Digital Input Unit

The PM 2132 Digital Output Unit provides 16-bit optically isloated output subdivided into 2 groups of 8 bits. Signal level is 0-5 for 0-30V. The outputs can be loaded up to 100 mA.

Technical Specifications

Configuration: 2 groups of 8-bit output with optical isolation, and a common line per group
For Output Details: See Table 1

Timing

Response Time on Setting Commands: <8 ms
Terminal: 37-pin female D-type connector
Display Module: The optional Pm 2190 Display Module shows
- Synchronization mode and ready status
- Data sent to the output

Current Consumption from System Supply: <200 mA

PM 2140 Analog Input

The PM 2140 Analog Input offers a 3-range input channel for DC voltages up to 25V, and a separate single-range current input up to 250 mA. The two inputs have a common floating low and are provided with a guard.

Maximum resolution is 10 µV in the 200 mV range and 10 µA in the current range. Measuring speed is 1.5 or 10 measurements per second. An input filter can be switched on for increased SMRR.

PM 2140 also includes two relays that can be activated by the input signal when passing a programmable high or low limit. The contacts of these relays are connected to rear-mounted terminals.

Technical Specifications

Configuration: 3-range DC voltage and single range DC current input with floating low and a guard. High and low limit detection with relays for external signalling.

Operating Modes

Mode 0: Measurements with 4 digit resolution
Mode 1: Measurements with 3 digit resolution
For Ranges and Accuracy: See Table 2

Limit Detection

Limit Setting Range: -25,000 to +25,000 counts
For both high and low limit:
  Max. Limit Relay Load: 10W
  Max. Voltage: 30V rms or 42 VDC
  Max. Current: 500 mA
Start of Measurements: Free-running or triggered via the systems bus. Measuring results are available 80 ms (mode 1) or 600 ms (mode 0) after start of measurement
Terminal: 37-pin female D-type connector
Display Module: The optional module PM 2190 shows:
- Operating mode, trigger mode and ready status
- Measured value
- High limit setting
- Filter on/off

Current Consumption from System Supply: Max.<100 mA

PM 2141 Digital Input Unit

The PM 2141 is a 12-bit Digital-to-Analog Converter, which offers a choice of both voltage and current output modes. The voltage output mode has two ranges, ±2V and ±20V and the current output mode has one range, ±20mA. The voltage and current output modes have a resolution of 2000 digits. Both of the outputs are floating with respect to the system and safety grounds. For safe operation, the output voltage must never exceed 42V (DC or DC + AC peak). The voltage output has optional separate sensing wires to eliminate voltage drop across the output wires. This option allows a power supply to be added to increase output power.

Technical Specifications

Programmed Output Voltage (Mode 1)

Output Voltage Range: -2 to +2 V
Current Range: -10 to +10 mA
Resolution: 10 mV (1:4000)
Accuracy: +(0.1% of value + 0.1% of range)
Output Impedance: 0.1Ω (or 1 mV/10 mA)

Programmed Output Voltage (Mode 2)

Output Voltage Range: -20 to +20V
Current Range: -10 to +10 mA
Resolution: 10 mV (1:4000)
Accuracy: +(0.1% of value + 0.05% of range)
Output Impedance: 0.1Ω (or 1 mV/10 mA)
Output Voltage (max): +20.5V

Programmed Output Current (Mode 3)

Output Voltage Range: -20 to +20 V
Current Range: -9 to +9 V
Resolution: 10 µA (1:4000)
Accuracy: +(0.1% of value + 0.05% of range)
Output Impedance: 0.1 µA/V
Output Admittance: 0.1 µA/V/K
Temperature Coefficient: +(0.0%/K of value +0.005%/K of range)

General Specifications

Response Time: Approx. 50 ms after master unit
Setting Time: Time between old and new output
Display Module: Optional display adapter PM 2190 shows:
- Mode
- Output voltage
- Output current

Input Voltage: 7 to 15 VDC
Current Consumption from System Supply: Approx. 200 mA at 12 VDC, no load approx. 250 mA at 12 VDC, max. load

PM 2160 Temperature Unit for Pt 100

The PM 2160 offers temperature measurment with Pt 100 sensores from -200°C to +850°C to a resolution of 0.1°C. The result is linearized and output in ASCII for direct input to a system controller.

Results can be compared to preset high and low limits. If they are exceeded, a warning is sent to the controller and the respective relay in the unit is activated.

Technical Specifications

Configuration: Single 4-wire connection to Pt 100 sensor. Current source/voltage input float w.r.t. main system
Operating Mode: Fixed
Measurement Range: -200°C to +850°C, resolution 0.1°C
Overload Indication: 999.9°C
Accuracy (not inc. sensor): +0.1% +0.5°C (-100°C to 850°C) +0.1% + 1°C (200°C to -100°C)
Temperature Coeff.: +(0.01% + 0.1°C)/°C
Common Mode Voltage: Floating sensor connection max. 30V rms or 42 Vpeak or DC w.r.t.
Measurement Time: 0.5s (-50°C to +250°C) 0.63S max. at -200°C 1.25s max. at +850°C
Measurement Trigger: Free running or triggered by systems bus
Limit Relay Output
  Max. Switching Voltage: 30V AC or 42V DC
  Max.Switching Current: 0.5 A
  Max. Switching Power: 10 W

Table 1. Input and Output Specifications for PM 2130, 2131, 2132

	Input	Output
Common Mode Voltage Between Groups and Ground	30V rms AC or 42 VDC	30V rms AC or 42 VDC
Supply Voltage	5 to 30V	5 to 30V
Supply Current	<10 mA (per group of 4 bit)	<1A (per group of 8 bits and including max. load current)
Logic	Positive	Positive (current source)
Levels	Low for <30% of supply voltage High for >70% of supply voltage	
Hysteresis	0.4V to 1.7V	
Input Voltage Range **Input Resistance** **Input RC Time**	-30 to +30V 100 kΩ 0.1 ms	
Max. Load Current		100 mA (outputs may be used in parallel)
Output Voltage		Supply voltage -1V at 100 mA load
Current at Output Low		<1 mA
Output Protection		Short-circuit protected and flyback diodes

Limit Parameters: The output can be compared with a high and low limit (+850°C or -200°C). Out of limit generates an SRQ signal for the controller, and activates high or low relays, accessible on the rear panel
Contact Resistance: 100 mΩ
Terminals: 37-pin female D-type connector
Display Module: Optional PM 2190 shows trigger mode and ready stauts; measured value (or overload); and high and low limit value
Current Consumption from System Supply: Max. 100 mA

PM 2150 User Adaptable Unit

The User Adaptable Unit allows the connection of a user-build function to the IEEE-488 bus. For this reason, fixing facilities, power supply and a connector for a standard Eurocard are provided in the unit. For interfacing to the user-build function, 16 I/O lines are available for use in most any configuration of inputs and outputs.

Technical Specifications

Configuration: Two groups of 8 I/O lines, read or written in groups, and with a common return
Signal Levels: CMOS 5V compatible with 10 kΩ pull-up
Power Supply: A maximum of 200 mA at 5V ±5% is available for user-build circuitry
Use of I/O Lines: The 16 I/O lines can be used in any I/O line configuration
Reference Facility: A matching state of I/O lines can be detected by reference setting. The corresponding warning flag can be used to generate a service request message. The reference pattern can consist of: "don't care", Low, High or "changing state" bits.

Timing

Response Time on Read or Write Command: <8 ms
Min. Pulse Width to set "match reference" Flag: 5 ms
Control Commands: All I/O lines can be set or read individually or in combination in binary, decimal, hexadecimal or ASCII code. The reference can be set in binary, decimal or hexadecimal codes ("don't cares" and "change state" in binary code only)
Display Module: The optional Display Module shows:
- Synchronization mode and ready status
- Data sent to the I/O lines
- Status of the I/O lines

Current Consumption from System Source: 50 to 250 mA depending on circuitry

Accessories

PM 2190 Display Module

The PM 2190 Display Module has an 8-digit LCD to show programmed modes and settings of the Slave Units during debugging. The module can be plugged onto the front panel connector of each Slave Unit.

(The parameters shown on the Display Module are specified for each Slave Unit).

PM 2191 Terminal Adapter

The PM 2191 Terminal Adapter adds a screw-connection terminal to Slave Units which have a 37-pin D-type terminal.

PM 2192 Extension Cable Set

A set of flat cables and connectors enabling the System 21 internal bus to be extended so that units can be used at different places in a rack. The set contains:
- 1M flat cable with an internal bus connector at one end
- 3 additional connectors

PM 2193 19"Rack-Mount Kit

This rack-mount kit allows up to 8 System 21 units to be mounted in a standard 3E high rack unit. Wiring for interconnection of the units is provided as standard.

PM 2194 Blank Panels for Rack-Mount Kit

PM 2194 provides blank panels for the PM 2193 Rack-Mount Kit. The rack-mount kit holds up to eight System 21 modules. If less than eight modules are used the blank panels will cover any of the empty locatons in the rack-mount kit.

The PM 2194 provides enough pieces to cover seven locations of the rack-mount kit, if only one System 21 module was used.

PM 2198 Additional Power Supply Unit

In extensive systems requiring more current than the 750 mA capacity of the PM 2101 Master Unit, additional PM 2198 Power Supply Units can be connected in parallel. Each additional PM 2198 provides an additional 750 mA.

Technical Specifications

Power: 110, 120, 220 or 240 VAC ± 10%, 50 or 60 Hz
Power Consumption: 16 VA max.
Safety: Class II acc. to IEC 348
Secondary Power Supply for Slave Units: 7.5V (at full load) to 16V (unloaded)
Maximum Current Load: 750 mA

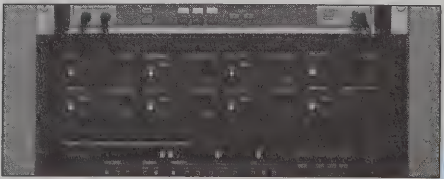


Table 2. PM 2140 Ranges & Accuracy

	VDC 200 mV	VDC 2V	VDC 20V	IDC 200 mA
Reading Ranges				
Mode 0	±250.00 mV	±2.5000V	±25.000V	±250.00 mA
Mode 1	±250.0 mV	±2.500V	±25.00V	±250.0 mA
Max. Resolution	10 µV	100 µV	1 mV	10 µV
Accuracy: % of Reading ±% of Range	0.1 ±0.02	0.1 ±0.02	0.1 ±0.02	0.25 ±0.05
Temp. Coeff. %/°C	0.01	0.005	0.005	0.05
Input Characteristic	1 MΩ	10 MΩ	10 MΩ	1Ω
SMRR (at 50 Hz)				
Mode 0 filter on	>60 dB	>70 dB	>70 dB	
filter off	>40 dB	>50 dB	>50 dB	
Mode 1 filter on	>50 dB	>60 dB	>60 dB	
filter off	>30 dB	>40 dB	>40 dB	
Input Settling Time for Last Digit				
Mode 0 filter on	750 ms	750 ms	750 ms	450 ms
filter off	150 ms	150 ms	150 ms	100 ms
Mode 1 filter on	550 ms	550 ms	550 ms	350 ms
filter off	75 ms	75 ms	75 ms	75 ms
CMRR	100 dB at DC 80 dB at AC (50 Hz)	100 dB at DC 80 dB at AC (50 Hz)	100 dB at DC 80 dB at AC (50 Hz)	100 dB at DC 80 dB at AC (50 Hz)
Avg Measuring Speed				
Mode 0	1.6 per second	1.6 per second	1.6 per second	1.6 per second
Mode 1	10 per second	10 per second	10 per second	10 per second
Maximum Load	42 VDC (tested up to 250V rms)	42 VDC (tested up to 250V rms)	42 VDC (tested up to 250V rms)	1.5A average and 10A peak

System 21

Ordering Information

Models

January 1989 prices

PM 2101/013 Master Unit	$690

Switches

PM 2120/01 Universal Switch	480
PM 2121/01 Low Level Switch	600
PM 2122/01 50Ω Coaxial Switch	680
PM 2123/01 1Ω Ghz Switch	995
PM 2124/01 Current Switch	680
PM 2125/01 Probe Switch Driver	450
PM 2195/09 Probe Switch	650

Digital I/O

PM 2130/01 Digital I/O Unit	$575
PM 2131/01 Digital Input Unit	575
PM 2132/01 Digital Output Unit	575

Data Acquisition & Custom Units

PM 2140/01 Analog Input Unit	600
PM 2141/01 Analog Output Unit	695
PM 2150/01 User Adaptable Units	395
PM 2160/01 Pt-100 Temperature Unit	600

Accessories

PM 2190/01 Display Unit	195
PM 2191/01 Terminal Adapter (qty: 3)	199
PM 2191/10 Terminal Adapter (qty: 1)	$70
PM 2192/01 Bus Extension Cables	60
PM 2193/01 Rack Mount Kit	235
PM 2194/01 Blank Panel for Rack Mount	80
PM 2198/013 Additional Power Supply	360

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. For other power options, see Introduction Section, page 491.

System 21 Selection Chart

Master and Custom Units							Maximum Power	Connector Type	U.S. Price	Description
PM 2101	GPIB Master Unit						16VA	GPIB	$690	Controls and powers up to 50 slave units. Uses only one GPIB address.
PM 2150	Customer Adaptable Unit						200 mA at 5V ±5%	Euroconnector for a Eurocard	$395	Allows the development of custom slave units. Uses 5V CMOS or TTL chips.

Switches		Number of Switches Mode 1	Mode 2	Mode 3		Switching Speed	Maximum Switching Power	Connector Type	U.S. Price	Description
PM 2120	Universal Switch	20	10	10		10 to 20 ms Note 1	30V 200 mA	37 pin (D) female	$480	20 individual ON/OFF switches. 10 SPDT over switches.
PM 2121	Low Level Switch (3 μV Thermal Offset)	20	10	4		<10 ms Note 1	24V 500 mA	37 pin (D) female	$600	1, 2 or 4 pole switching, with guard lines protected against current transitions.
PM 2122	50Ω Coaxial Switch	4	—	—		<10 ms Note 1	24V 500 mA	BNC	$680	A VHF coaxial switch with a 50Ω impedance for DC to 500 MHz.
PM 2123	18 GHZ Coaxial Switch	5	—	—		<40 ms Note 1	15W	SMA jack	$995	Controls 5 microwave switches, one of which is mounted inside the unit.
PM 2124	Current Switch	6	—	—		(50 + 50 x n) ms n=1 to 6 Note 1	2500VA AC 300W DC	Amphenol 97 Series	$680	Allows the switching of high currents and high voltages, 10A and 250V.
PM 2125	Probe Switch Driver	4	—	—		50 ms Note 1	—	8-pole DIN female	$450	Controls four PM 2195 probe switches, each of which can select 4 probes.
PM 2195	Probe Switch	—	—	—		See PM 2125	400 MHz bandwidth	8-pole DIN male	$650	Provides four probes which are suitable for oscilloscopes, counters, timers, etc.

Digital Input/Output		Number of Channels Inputs	Outputs			Switching Speed	Maximum Voltage	Connector Type	U.S. Price	Description
PM 2130	Digital Input/Output	2 x 4	8			<8 ms Note 1	30V rms	37 pin (D) female	$575	2x4 optically isolated inputs and 8 optically isolated outputs.
PM 2131	Digital Input	4 x 4	—			<8 ms Note 1	30V rms	37 pin (D) female	$575	4x4 optically isolated inputs, externally powered.
PM 2132	Digital Output	—	2 x 8			<8 ms Note 1	30V rms 42V peak	37 pin (D) female	$575	2x8 optically isolated outputs, protected against short circuiting & inductive loads.

Data Acquisition		Input/Output Ranges Voltage Range 1	Voltage Range 2	Voltage Range 3	Current Range 1	Measurements Per Second	Maximum Power of the Switching Relay	Connector Type	U.S. Price	Description
PM 2140	Analog Input Resolution:	200 mV 10 μV	2V	20V	250 mA 10 μA	1.6 to 10	10W	37 pin (D) female	$600	A Analog-to-Digital converter with programmable High and Low limit relays.
PM 2141	Analog Output Resolution:	±2V 1 mV	±20V 10 mV	—	±20 mA 10 μA	—	—	37 pin (D) female	$695	A 12-bit Digital-to-Analog converter with two voltage and one current range.
PM 2160	Pt-100 Temperature Unit	Pt-100 RTD	—	—	—	.8 to 2	10W	37 pin (D) female	$600	An input module for Pt-100 RTDs with programmable High and Low limit relays.

Note 1: These times work out to approximately 6 per second for an average combination of slave units programmed in BASIC on a PC, using block programming mode.

FlexSys (1790A)

1790A

FlexSys ATE Workstation Software (For 1722A)

- Provides the advantages of IEEE Std. 716 ATLAS language at a fraction of the cost of other solutions
- Allows reconfiguration (changing system hardware elements) without recompiling or modifying test programs
- Touch-sensitive, menu-driven user interface means easy training and use
- Compact workstation fits on bench or in the rack
- Includes programming tools such as syntax checking, utilities for efficient debugging, and easily customized screen menus
- Integrates a wide range of ATE equipment via GPIB/IEEE-488
- High-speed compile — typical 500 ATLAS statements per minute

FlexSys is a complete ATLAS software package that runs on Fluke's powerful GPIB/IEEE-488* controller, the 1722A. For both large and small system applications, it provides the benefits of the ATLAS language at a fraction of the cost of other systems.

With FlexSys, reconfiguration is rapid and easy without recompiling or modifying test procedures or test program sets through the use of Resource Descriptions (RDs). The result is lower cost for software development.

The Resource Description, the heart of FlexSys is a data base of instrument characteristics utilized by the system at run time. RDs define the codes and formats for a given instrument as well as the accuracies, ranges, timeouts and delays. The use of RDs at run time facilitates the rapid and straightforward configuration of the ATE system. Test program set development is independent of the specific hardware elements in the ATE system.

FlexSys provides for:

- ATLAS Test Program Set (TPS) development
- Resource Description development
- ATE configuration
- Test execution in a real-time or simulated mode of operation

Test Program Set Development

A touchscreen, menu-driven interface allows the FlexSys user to develop test program sets and retain a history of inputs easily and efficiently.

A parsing editor provides both manual and automatic syntax checking during development of ATLAS test program sets.

The ATLAS Compiler prepares ATLAS test procedures for execution through:

1. Verification of ATLAS syntax, semantics.
2. Generation of executable binary files.
3. Covering or comparing signal statement requirements to corresponding require statements to verify that the defined virtual resources can meet test program requirements.
4. Cross-reference table listing the connections between instrument ports and unit under test (UUT) pins.

The Non-ATLAS procedure capability is used for the following:

1. Access to 20 predefined IEEE-488 bus drivers. The bus drivers allow direct control of 13 lines of the bus — the eight data lines and five control lines. The most common use of these drivers would be to manipulate a UUT which is controlled through the 488 interface. The drivers may also be used to control ATE functions not currently supported by IEEE ATLAS.
2. Perform user defined procedures displaying custom screen menus through a library of touchscreen menus allows full operator interaction with a running ATLAS TPS without the need for a keyboard.
3. Perform user defined procedures that utilize the pixel graphics capabilities of the 1722A. The user can create Non-ATLAS Procedures in FORTRAN, C, or Assembly language.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

FlexSys (1790A)

Resource Description Development

With FlexSys actual resources used at run time need not be predefined — a feature unique among ATE systems. Instead, real resources (station test equipment) which meet the conditions of ATLAS REQUIRE statements are specified after compilation of the ATLAS test procedures. Information contained in the Resource Description Data Base specifies the following:

- Available functions and capabilities.
- Native IEEE-488 bus codes that control the instrument.
- The data format of information returned to the controller.
- Miscellaneous information such as settling times, instrument error codes, etc.

This data is used at run time, allowing compilation to be accomplished independent of real resources. RDs for system resources may be written by the user, or may be purchased from Fluke.

System Configuration

Configuration integrates the instruments on the 488 bus into a functional ATE test station. The System Configuration process gives the user the ability to configure and reconfigure his system with minimal cost and effort by allowing the test program sets to be run without modification or recompilation after reconfiguration of the test station.

The configuration process identifies the instruments connected to the bus and creates a Resource Description Table. This table is a collection of resource descriptions, for each instrument in the test station. ATE configuration is independent of the ATLAS test program set so that the ATE configuration need not be re-established as long as the instruments on the bus do not change.

Resource assignment establishes the logical mapping of the real resources on the bus to the virtual resources specified by the ATLAS test program set to perform the following:

- Assign a real instrument resource for each virtual resource in the test program set.
- Check that the real resources on the bus do, in fact, satisfy the virtual resources specified in the ATLAS REQUIRE statements.
- Choose signal paths which are defined in the system interface RD for use at run time.

Test Execution

Test Execution provides for:

- TPS Selection
- Simulation
- Execution
- Debug Monitoring

TPS Selection

TPS Selection allows the test operator to select from available test programs. This is conveniently done using the touch-sensitive screen to page through possible selections and designate which test program to execute.

Simulation

Simulation provided to allow a test programmer to verify correct operation of test procedures and resource descriptions without actual use of the ATE system.

Test Execution

The test equipment is controlled using the programming codes extracted from a resource description to perform the operations defined by the ATLAS signal statements.

Debug Monitor

The debug monitor commands include single step execution, setting break points, enable program trace and examination of program variables. The test engineer may examine and alter system flags and the command buffers sent to the instruments. The debug monitor allows debugging to take place at the ATLAS statement level.

Documentation

Documentation is presented for both the novice and advanced users.

Product documentation includes:

- Getting Started Manual
- System Guide
- System Configuration Manual
- ATLAS Program Development Manual
- Resource Description Development Manual

The FlexSys manual set is organized in reference form, with tab dividers, indexes, section headers on each page, and a consistent readable format. The manuals are supplemented with tutorial introductions and numerous examples.

The FlexSys ATE Workstation is available in three configurations:

Model 1790A-500

ATE System Development Software: Provides all capabilities required for resource description development, station configuration, TPS development and test execution, simulation, and non-ATLAS module linkage, complete with sample RDs and test program sets.

Model 1790A-400

TPS Development Software: Provides the capabilities required for TPS development, configuration and execution (for the user who does not develop his own RDs).

Model 1790A-300

Test Execution Software: Provides all capabilities required for execution of ATLAS test program sets.

Options

1790A-301 Configuration (available only as an option for 1790A-300) (Included in -500 and -400)

This option allows for the rapid reconfiguration of hardware within the test station without recompilation of ATLAS test procedures.

Ordering Information

Models

January 1989 prices

1790A-500	ATE System Development Software	$21,950
1790A-400	TPS Development Software	18,950
1790A-300	Test Execution Software	5250
1790A-301	Configuration	250

Optional Resource Descriptions

Calibrators

1790A-RD01	RDs for Fluke DC Calibrators (5440A, 5440B, 5442A)	400
1790A-RD02	RD for Fluke 5200A AC Calibrator	200
1790A-RD03	RD for Fluke 5450A Resistance Calibrator	200

DMMs

1790A-RD21	RDs for Fluke DMMs (8502A, 8505A, 8506A)	800
1790A-RD22	RD for Fluke 8520A Digital Multimeter	400
1790A-RD23	RD for Fluke 8520A/AS-1 Digital Multimeter	600
1790A-RD24	RDs for Fluke DMMs (8840A, 8842A)	400
1790A-RD25	RDs for Hewlett-Packard DMMs (3455A, 456A)	800
1790A-RD26	RD for Hewlett-Packard 3478A DMM	400
1790A-RD27	RD for Keithly 192 Programmable DMM	400

Power Supplies, Power Meters

1790A-RD41	RDs for Fluke DC Power Supplies (4210A, 4216A, 4250A, 4265A, 4270A, 4275A)	400
1790A-RD42	RD for Hewlett-Packard 6002A DC Power Supply	400
1790A-RD43	RD for Hewlett-Packard 436A Power Meter	1000
1790A-RD44	RDs for Kepco Power Supply Programmers (SN488-031, SN488-032, SN488-121, SN488-122, SNR488-4, SNR488-8)	200

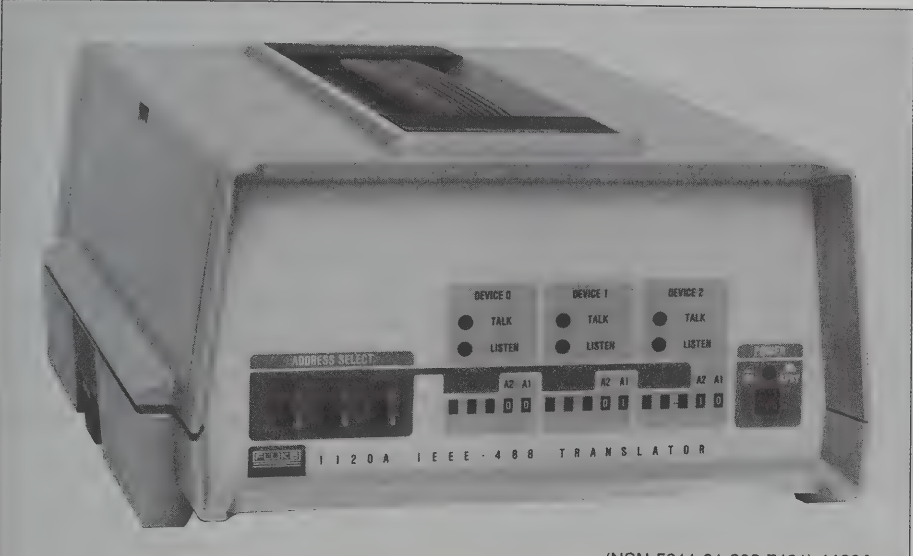
Signal Generators

1790A-RD61	RD for Fluke 6011A Signal Generator	600
1790A-RD62	RDs for Fluke Signal Generators (6060A, 6060B)	600
1790A-RD63	RDs for Fluke Signal Generators (6070A, 6071A, 6071A/AD)	600
1790A-RD64	RDs for Hewlett-Packard 8656A Signal Generator	600

Other

1790A-RD81	RD for North Atlantic 5310 Resolver Synchro Sim	200

1120A



(NSN 5811-01-202-7491) **1120A**

1120A IEEE-488 Translator

Fluke's Portable Test Instrumentation (PTI) system puts low cost instruments on the IEEE bus. The benefit is that you only pay for system capability if and when you need it. And neither size, weight, nor performance of the basic instrument is compromised for system capabilities you may not need. Instead of building interface capabilities into each low cost unit, we have designed a single instrument called the 1120A IEEE-488 Translator to do the interfacing job for you.

The 1120A is the communications link between IEEE Std 488-1978 and a variety of Fluke instruments. Operating between one or more instruments and the IEEE bus, the 1120A converts codes and signals on the bus to corresponding codes and signals compatible with the particular instrument. It passes address and control commands to an instrument or outputs data, or both, depending on the capabilities of the particular instrument being interfaced.

The 1120A is a translator for a number of Fluke instruments including universal counter/timers, communications counters, digital thermometers, frequency synthesizers, and digital ac voltmeters. Up to three instruments can be interfaced to the bus with a single 1120A, and multiple 1120As can be used in a system.

The 1120A connects instruments to the bus through an optional data output unit in the instrument and a "personality card" in the 1120A. Each personality card is individually addressable and "transparent" to other instruments. Each corresponds to a particular Fluke instrument model and is sold as an option to that instrument. The cards simply plug in to an 1120A which provides the necessary power and microprocessor-based circuits for their operation. The 1120A personality cards, accessory cables, and instrument data output units are designed to be easily assembled by the user. As your needs change, you can quickly change cards to accommodate other Fluke instruments. Many of the instruments and cables are sold as Option -521. If so numbered, they will operate directly into a Fluke 2020A (with Option -004) or 2030A Printer without an 1120A IEEE-488 Translator.

Building A System

Instruments that presently operate through the 1120A Translator to work in an IEEE-488 systems are: 2180A, 2190A, 6160B, 7220A, 7250A, 7260A, 7261A, 8920A, 8921A, and 8922A. Ordering Option -529 with most any of those instruments will get you all the things you need to connect the instrument to an 1120A Translator. However, check the catalog pages pertaining to each instrument to be sure.

For example, if you wanted to connect both a Fluke 7261A Counter and a Fluke 8920A Digital Voltmeter to other instruments on the IEEE-488 bus you could do so by ordering an 1120A Translator and checking the option descriptions for the 7261A and 8920A. You would find you need Option 892XA-529 (for the 8920A) and Option 72XXA-529 (for the 7261A).

Optional 1-meter, 2-meter, or 4-meter cables connect the 1120A Translator to other "bus instruments."

See the instrument index in the front of this catalog for a complete listing of IEEE-488 compatible instruments.

A 17-4 Bit Parallel Interface

A special circuit card may be fitted into an 1120A Translator that converts it into a general purpose translator between IEEE-488 bus systems and bit parallel data systems.

One A17-4 Card handles up to 32 digital inputs and/or outputs and up to three A17-4 cards will fit in one 1120A Translator.

Any, or all, of the 32 bits may be used as input and/or output. However, these bits must be organized in groups of four or eight. BCD, binary and hexadecimal modes may be chosen, or for status outputs any single bit may be set or reset without altering other bits in the binary or hex mode.

The A17-4 can be set to continuously monitor any designated single port (8 or 4 bits). It will then request service whenever any bit of that port, which is enabled by the SRQ mask, changes to a logic True.

The A17-4 has an output strobe line which may be used to trigger or latch external devices when the data on the output lines is valid. Similar capability is optional in the 2400B, 2280B, and the 1722A with Option -002.

For more information ask for Bulletin A0143.

Ordering Information

Model

	January 1989 prices
1120A IEEE-488 Translator	$590
A17-4 Bit Parallel Interface	on req

Accessories (Also see page 485)

Y8021 1m (39.4 in) Shielded Cable	130
Y8022 2m (78.8 in) Shielded Cable	145
Y8023 4m (13 ft) Shielded Cable	155

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1120A Repair	64

PM 2534 & PM 2535

PM 2535

PM 2534 & PM 2535 GPIB Instrumentation System

- $3^1/_2$ to $6^1/_2$ digits
- 100 nV resolution
- 100 measurements
- GPIB/IEEE interface standard
- Front or rear inputs
- Scanner extension

The Philips PM 2534 and PM 2535 GPIB Instrumentation Systems cover a broad range of applications. While both instruments are suitable for a wide range of general purpose measurements, the PM 2535 offers additional advanced functions for applications demanding data gathering and fast measurement collecting and processing.

Basic Features

Both the PM 2534 and PM 2535 offer seven measurement functions, front or rear inputs and $6^1/_2$ digit guarded sensitive measurements or up to $3^1/_2$ digit high speed measurements. The units can operate in scan mode under external control via the GPIB/IEEE-488* interface.

Extra Capabilities of the PM 2535

As well as the above features, the PM 2535 has built-in data collection, advanced control facilities and calculations including Ax + B, Δ%, dBm and relative measurements. Maximum and minimum values can be stored over a time interval, and warnings can be given if specified limits are exceeded. Burst mode provides up to150 measurements/sec. Sequence programming allows repetition of the same measurement cycle; thus when combined with System 21 modules (see page380), allows the PM 2535 to act as a small data logger with no need for dedicated computer control.

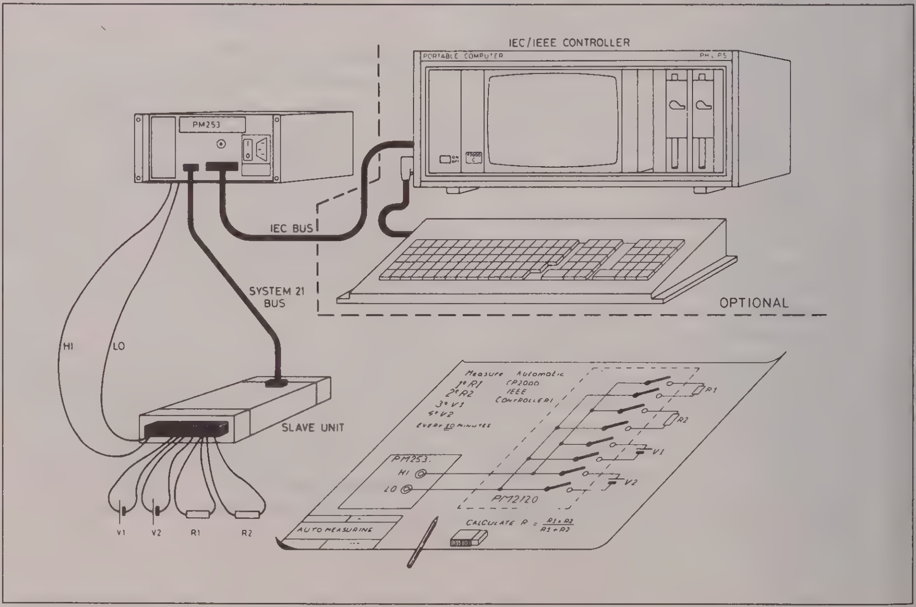
Computer Control

The PM 2534 and PM 2535 can be controlled via the GPIB or RS 232C interface. The PM 2535 also offers the following system capabilities: 10 functional measurement set-ups can be programmed including processing such as Ax + B, dBm or zero-set. With the SEQUENCE function these 10 functional set-ups can be made automatically and sequentially. When combined with the burst mode, the measurements made can be stored in the PM 2535 until read by the computer, thus freeing the computer to handle other routines.

Controlling System 21 Modules

Many system applications demand measurements to be made at a number of different points and require large and expensive scanners. But with the PM 2534 and PM 2535, System 21 can be added to any GPIB application to provide a modular and cost-effective solution to system switching. Both the PM 2534 and PM 2535 have a System 21 Master Unit built-in, enabling them to control any system 21 switch units.

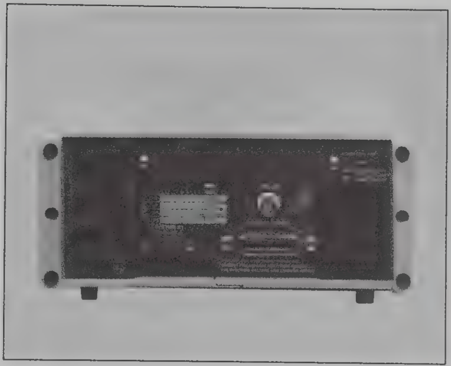
System 21 slave units connect to the internal bus connector on the rear of the PM 2534 or PM 2535 with a PM 2192 Extension Cable Set. In addition, control commands are accepted via the PM 2534 or PM 2535 GPIB interface and retransmitted to the System 21 internal bus, eliminating the need for costly interfaces, cables and power supplies.



**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Controlling System 21 without an Instrument Controller

The PM 2535 also has the capability to control System 21 slave units without the need of an instrument controller. Through the SEQUENCE function, the PM 2535 can create a 99 step program. Each step of the program is associated with one of ten functional DMM set-ups. Both the SEQUENCE program and the 10 functional DMM set-ups are stored in non-volatile memory in case of power loss. With these two functions, a small data logging system providing scaled measurements can be achieved with the PM 2535 without dedicating an instrument controller to the task.



Rear view of PM 2535 showing duplicated front panel input sockets, data bus interface and System 21 connectors.

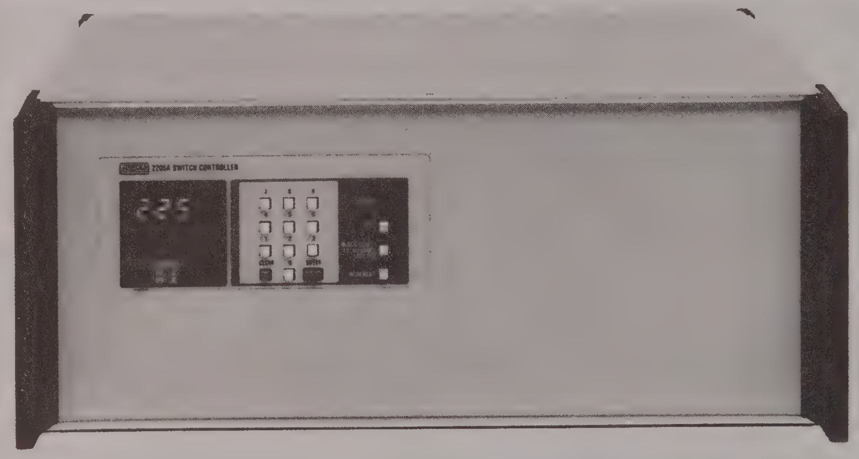
Multidrop

Multidrop is another possibility to operate in smaller systems. This mode allows a number of devices to be controlled by the same instrument controller. Data flow is controlled by using the SOH-ETX or STX-EOT protocol. A device is selected by SOH or STX followed by a selected character, and deselected by the same character. In this manner multiple instruments can be controlled by the RS 232C interface.

Ordering Information

For Technical Specifications and Ordering Information of the PM 2534 and PM 2535 see page 83.

2205A



PM 2205A

2205A Switch Controller/Scanner

- Plug-in modules that expand the versatility of the 2205A
- Channel expansion (up to 1000)
- Matrix latching
- Low level and thermocouple scanning
- Two-wire or four-wire resistance scanning
- Actuator/Relay control
- Remote operation via GPIB/IEEE-488 interface (included)

Versatile Switching, Latching, Scanning

The microprocessor-based 2205A Switch Controller offers a wide variety of switching, scanning, and matrix-latching capabilities for applications in production testing, process monitoring, process automation, calibration, etc.

The 2205A may be operated or programmed from the front panel to perform periodic switching operations. Or it may be directed remotely in a system compatible with IEEE Std 488-1978 to perform complex switching operations.

Five Switching Options

Five kinds of switching module options are available. They plug into the 2205A mainframe and any combination of up to ten modules may be plugged in at the same time. Model 2201A or 2202A Extender Chassis allows for expansion of a system to accommodate up to 100 modules.

Three of the five types of switching options are for scanning analog signals and measuring them with a DMM. One of the three is for measuring low level signals such as the output voltage from thermocouples (-600), one is for general-purpose scanning (-300), and one is for measuring resistances using 4-wire connections (-400). Four wires are needed for precision measurements of low resistance values through long input wires. The latter option uses a pair of modules: a general-purpose module for the current-source leads and a low-level module for the voltage-sense leads.

Each module has ten reed relays and will scan ten points. The low-level reed relays switch a guard line as well as a pair of input leads.

Option -100 is an actuator module with five medium-power relays for controlling external and remote devices like indicators, actuators, alarms, power supplies, and other relays.

Option -200 is a matrix latching module that may be configured in one of three ways: either as a 1 by 8 matrix, as two 1 by 4 matrixes, or as a 2 by 4 matrix. This option features an 8 millisecond break-before-make switching speed and less than 10 microvolts of thermal offset.

Integrated Stimulus, Measurement, Control

The modularity of the 2205A makes it easy to configure switching in numerous ways. And that makes it a worthy building block for automated systems of various kinds. With the standard GPIB/IEEE-488* interface the 2205A becomes an integral part of a sophisticated system. Fluke offers numerous IEEE-488-compatible instruments including the 1722A or 1752A Instrument Controller, signal sources, power sources, calibrators, digital voltmeters, counters, thermometers, data loggers, and printers. The IEEE-488 interface supports the following subset: AH1, L2, RL1, DC1, E2.

Specifications

2205A Specifications

Control: Manual, panel-programmed scan, or via IEEE-488 Interface

Panel Controls: Select channels to be scanned, actuated, or latched. Scan rate selectable in 0.1 second increments from 0.2 seconds to 3.3 seconds per channel using behind-the-panel control

Switch-Module Slots: Ten, expandable to 100 using several 2201A (12-slot) or 2202A (10-slot) Extender Chassis

Display: 3-digit LED. Shows active channel number. Also shows assigned address (using IEEE-488 Interface) at time of power-up

Trigger Output: Rear panel BNC connector. TTL level. Adjustable delay. To trigger measurements following moments when switching occurs

Analog Output: To digital multimeter via rear panel output connector. Guarded 2-wire or guarded 4-wire connections. Common-mode voltage 170V dc or peak ac

Other Inputs and Outputs: Via module connectors included with modules

Internal Scanning Bus: Two 3-wire buses. One is common to even-numbered module slots; the other is common to odd-numbered slots. Goes to analog output. Input resistance is greater than 10 GΩ on HI or LO with respect to power line ground.

2201A Specifications

Switch-Module Slots: 12 in each 2201A. Up to 100 slots (1000 channels) per system

One or more 2201A Extender Chassis may be connected to a 2205A via a six-foot cable supplied with each 2201A. Power and control for the modules is supplied by the 2205A.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Option Specifications

Actuator Control Module (-100)

Relays: Five, SPDT
Switching Time: 20 ms*
Contact Rating: 1A maximum at up to 26V dc or 30V rms ac. 3A fuse in each common line
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -110K and -010K

Matrix Latching Module (-200)

Relays: Eight, latching, DPST with unswitched guard, break-before-make
Switching Time: 8 ms*
Rating: 40 mA maximum to 170V dc or peak ac, max
Bandwidth: Dc to 1 MHz (±0.1 dB) into 600Ω to 1 MΩ load
Thermal Offset: <10 µV
Configurations: One 2x4 matrix, two 1x4 matrixes, or one 1x8 matrix
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -210 and -009K.

General-Purpose Scanning Module (-300)

Relays: Ten, reed type, DPST with unswitched guard
Scan Rate: 125 channels per second, max*
Rating: 40 mA maximum. A 0.5A fuse in each input line
Thermal Offset: <10 µV
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -310K and -009K.

Low-Level Scanning Module (-600)

Relays: Ten, reed type, 3PST, switched guard
Scan Rate: 80 channels per second, maximum*
Rating: 15 mA maximum to 35V peak
Reference Junction Output: 540 mV at 25°C
Thermal Offset: <1 µV
Connectors: Screw terminals on isothermal block to minimize temperature differences between terminals when scanning thermocouples. Reference junction temperature-sensing circuit on isothermal block provides automatic compensation to thermocouple output signals. Terminals are mounted on edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -610K and -008K

Four-wire Ohms (-400) (-300 plus -600)

Two modules per option, used in adjacent slots. Switch both current-source and voltage-sense connections for precision resistance measurements. Specifications for current sourcing are the same as for Option -300. Specifications for voltage sensing are the same as for Option -600, except reference junction temperature sensing circuits are not available. Comprised of -310K and -009K plus -610K and -008K. For applications requiring more than 50 four-wire ohm circuits, the 2200A-7000/AU adapter and pairs of 2201A Extender Chassis are required.

**These times are 2205A times and do not necessarily reflect system specs*

General Specifications

Temperature: 0°C to 50°C, operating; -55°C to +75°C, non-operating
Relative Humidity: ≤80% to 40°C, operating
Power: 100, 120, 220, or 240V ac ±10%, 50 to 60 Hz, selectable from rear panel. 25W maximum
Size: 17.8 cm H x 43.2 cm W x 44 cm D (7 in x 17 in x 17.4 in)
Safety: IEC 348 Protective, Class 1
Weight: 7.1 kg (15.6 lb)
Included
2205A: Manual, power cord, 3-foot Y8076 analog output cable for 8502A-16, 8505A, 8506A, 8520A, or 8860A-06 DMM
2201A: Manual, six-foot cable for connecting to 2205A
2202A: Manual, power cord but no cable

Ordering Information

Models

January 1989 prices

2205A Switch Controller including IEEE-488 Interface	$2590
2201A Extender Chassis	1900

Options

-100 Actuator Control	400
-200 Matrix Latching	400
-300 General-Purpose Scanning	400
-400 4-Wire Ohms Scanning	960
-600 Low-level Scanning	560

Accessories (Also see page 485)

2205A-008K Spare Low-Level Connector	$120
2205A-009K Spare General-Purpose Connector	120
2205A-010K Spare Actuator Connector	110
2205A-110K Spare Actuator Card	360
2205A-210K Spare Matrix Latching Card	360
2205A-310K Spare General-Purpose Scanner Card	360
2205A-610K Spare Low-Level Scanner Card	450
2200A-7000/AU Multi-Channel 4-Wire Ohms Adapter	on req
Y8021 1m Cable for IEEE-488 Bus	130
Y8022 2m Cable for IEEE-488 Bus	145
Y8023 4m Cable for IEEE-488 Bus	155
Y8004 1.5m RS-232-C Cable	110
Y8013 Trigger Output Cable, 4-foot	25
Y8076 Analog Interface Cable (included w/2205A) 3-foot	125
M07-205-600 7" Rack Adapter	110
M00-260-610 18" Rack Slides (needs M07-205-600)	130
M00-270-610 20" Rack Slides (needs M07-205-600)	130
M00-280-610 24" Rack Slides (needs M07-205-600)	130

**-7001 and -7002 both required with 2202A*

Service & Support

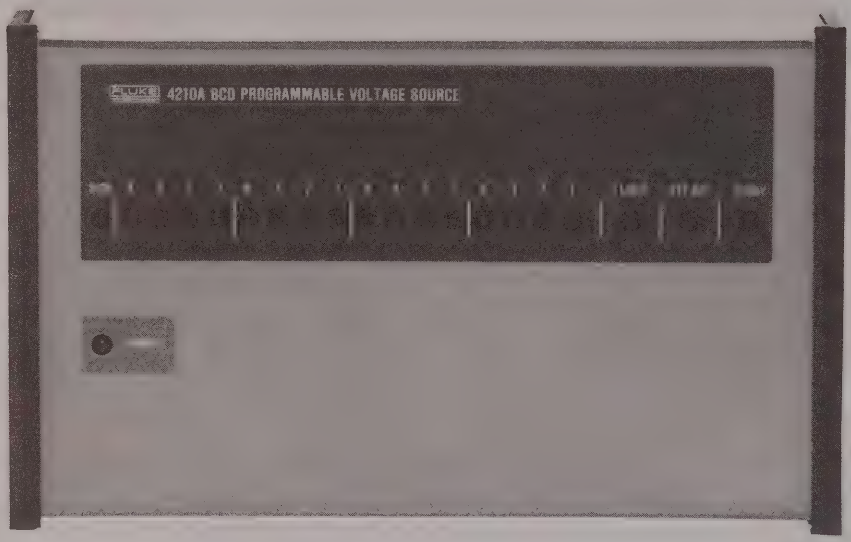
Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2205A Repair (w/calibration)	420
SC1-2205A Repair (cal w/in or out data)	455
SC1-2205A Repair (cal w/in and out data)	490
SC2-2205A Cal (1 per yr recommended)	31
SC2-2205A Cal (1 per yr w/in or out data)	66
SC2-2205A Cal (1 per yr w/in & out data)	101
SC1-2201A Repair (w/calibration)	163
SC1-2201A Repair (cal w/in or out data)	198
SC1-2201A Repair (cal w/in and out data)	233
SC2-2201A Cal (1 per yr recommended)	31
SC2-2201A Cal (1 per yr w/in or out data)	66
SC2-2201A Cal (1 per yr w/in & out data)	101

4200 Series



4210A

4250A

4200 Series Power Supplies

- IEEE-488 or parallel interfaces
- BCD or binary 2s complement coding
- Isolated digital control of ac and dc external sources
- Up to 65V at 1 amp or 110V at 1/2 amp
- Fully guarded
- ±0.01% accuracy
- 100 µV resolution capability
- 30 to 110 µs response time

The 4200 Series Programmable Power Sources are more than just precision digital-to-analog converters. They incorporate features that are not available in typical programmable power supplies: speed, accuracy, low programming noise, true current limiting, isolated control logic, output proportional to an external reference voltage.

These power sources may be operated in series or parallel, just like batteries. They will operate with up to 1000 volts between chassis ground and guard (250 volts with IEEE-488 interface). That allows you to use them as a programmable vernier for high voltage power supplies. Current sink capability, coupled with programmable current limits, allows four of the six models to be used as a dynamic load.

Isolated Control Logic Option (-01)

Isolated control logic is parallel BCD for the 4210A, 4250A, and 4270A and 14-bit or 16-bit parallel binary for the 4216A, 4265A, and 4275A and is available as Option -01. However, any of the six models may be ordered with multi-strobe logic (Option -09) or with an interface for compatibility with IEEE Std 488-1978 (Option -05).

Multi-Strobe Logic Option (-09)

Allows programming directly from any 16-bit or 18-bit program source with addressing capabilities for up to eight 4200-Series Power Sources. The power sources may be in series as well as parallel. The control lines are electrically isolated from the output.

IEEE-488 Interface Option (-05)

The IEEE-488 interface allows the user to program the following functions using command character format: Voltage, current limit, external reference, range, polarity, SRQ response on errors, operate and standby. In addition to the normal command string format of programming, the IEEE-488 interface offers a "Direct Ladder Access" mode of programming. This mode is a 4-byte transfer sequence with limited IEEE-488 error and syntax checking, but with fast output results. The repertoire is SH1, AH1, T6, L4, SR1, DC1, and DT1.

External Reference Option (-03)

Output may be ac as well as dc. And, with Option -03, you have the ability to amplify or attenuate, by digital control, either an ac or dc voltage supplied by an external source. Output polarity matches input polarity. The 3 dB bandwidth is 100 kHz for the 4210A and 4216A, and 30 kHz for the other models.

Current Limit Option (-06)

To protect devices being powered, the output current can be automatically limited to any value between 10% and 110% of maximum output cur-

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

rent in 10% steps and 1% steps to 11%. Current is automatically limited at 120% of rated output when Option -06 is not installed.

High Resolution Option (-07)

To be able to program output voltage with 10 times better resolution than normal, Option -07 may be ordered for models 4210A, 4250A, and 4270A. Option -06 cannot be installed at the same time, however.

A4200 Manual Control Unit

For bench operation and calibration the A4200 is available as an accessory. It allows the operator to manually select each control line as well as monitor flag lines available from a power source. To view such characteristics as programming noise, settling time, rise time etc., an automatic mode is provided. When all the bits in any 8-4-2-1 decade are set, the power source will generate a staircase at the analog output which may be examined on an oscilloscope. The A4200 is not compatible with Option -09 or the IEEE-488 Interface Option (-05).

Specifications

Technical Specifications

Characteristics	1/2 Rack		Full Rack Width			
	4210A	**4216A**	**4250A**	**4265A**	**4270A**	**4275A**
Display	BCD	Binary	BCD	Binary	1BCD	Binary
Current Range	±100 mA	±100 mA	±1A	±1A	±0.5A	±0.5A
Option -06 Limit*	–	–	10% steps*	10% steps*	10% steps*	10% steps*
Regulation [1]	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%
Settling Time						
Within 0.1% of step	18 µs	18 µs	70 µs	70 µs	80 µs	85 µs
Within 0.01% of step	30 µs	30 µs	100 µs	100 µs	110 µs	110 µs
Low Voltage Range						
Voltage Range	±9.999	±16.383	±9.999V	±16.383V	±9.999V	±32.7675V
Resolution	1 mV	1 mV	1 mV	1 mV	1 mV	0.5 mV
W/Option -07	100 µV	–	100 µV	–	100 µV	–
90-Day Accuracy [2] ±0.01% of Output	±100 µV	±100 µV	±100 µV	±100 µV	±100 µV	±160 µV
90-Day Stability [3] ±0.003% of Output	±60 µV	±60 µV	±70 µV	±70 µV	±70 µV	±105 µV
Ripple and Noise [4]	300 µV rms	300 µV rms	500 µV rms	500 µV rms	500 µV rms	500 µV rms
Programming Noise	130 mV p-p	130 mV p-p	130 mV p-p	130 mV p-p	130 mV p-p	130 mV p-p
High Voltage Range						
Voltage Range	–	–	±65.00V	±65.53V	±99.99V	±110V
Resolution	–	–	10 mV	4 mV	10 mV	2 mV
W/Option -07	–	–	1 mV	–	1 mV	–
90- Day Accuracy [2] ±0.01% of Output	–	–	±700 µV	±300 µV	±700 µV	±530 µV
90-Day Stability [3] ±0.003% of Output	–	–	±490 µV	±210 µV	±490 µV	±370 µV
Ripple and Noise [4]	–	–	1 mV rms	1 mV rms	1.2 mV rms	1.2 mV rms
Programming Noise	–	–	260 mV p-p	260 mV p-p	260 mV p-p	260 mV p-p

** Also 1% steps to 11%. Limit at 120% of range without Option -06*

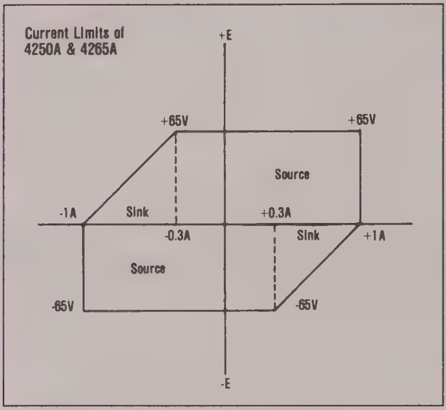
[1] Percent of output, no load to full load, ±10% line change

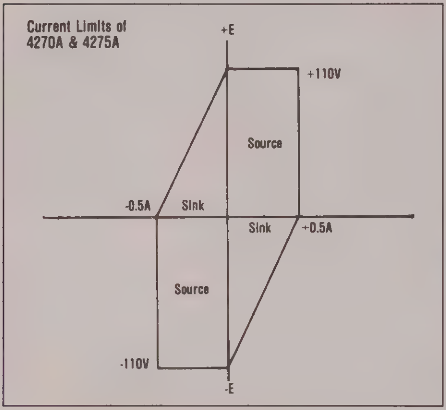
[2] 15°C to 35°C

[3] At constant line, load, and temperature

[4] 10 Hz to 10 MHz bandwidth

4200 Series





General Specifications

Shock: 120G, 11 millisecond half-sinewave
Vibration: 14.5G, 10 Hz to 55 Hz
Altitude: ≤10,000 feet, operating; ≤50,000 non-operating
Temperature: 0°C to 50°C operating; -40°C to <75°C non-operating
Power: 115V or 230V ac ±10%, 48 Hz to 62 Hz. 4210A and 4216A 15W; 4250A and 4265A 100W; 4270A and 4275A 200W

Size

4210A and 4216A: One half 19-inch rack width, 13.3 cm H x 21.6 cm W x 40.9 cm D (5.25 in x 8.5 in x 16.13 in)

Others: Full 19-inch rack width, 13.3 cm H x 43.2 cm W x 49.7 cm D (5.25 in x 17 in x 19.56 in)

Weight

4210A and 4216A: 5.5 kg (12 lb)

Others: 15.9 kg (35 lb)

Included: Instruction manual, power cord, mating digital input cable connector, screw terminal outputs. Order Y8021, Y8022, or Y8023 cable separately for Option -05

Ordering Information

Models

January 1989 prices

Model	Price
4210A* Programmable Power Source, 100 mA	$3400
4216A* Programmable Power Source, 100 mA	3400
4250A* Programmable Power Source, 1 A	4850
4265A* Programmable Power Source, 1 A	4850
4270A* Programmable Power Source, 500 mA	5250
4275A* Programmable Power Source, 500 mA	5250

**Interface Option -01, -05, or -09 is also required*

Options (for above Models)*

Option	Price
-01 Isolated Control Logic	630
-03 External Reference	440
-05 Interface for IEEE-488 bus	700
-06 Programmable Current Limit	420
-07 1100 µV Resolution (4250A only)	650
-09 (BCD/Binary) Multi-strobe Logic	1090

**See chart below for compatibility*

Accessories (See page 485)

Item	Price
Rack Adapters for 4210A and 4216A	
M05-200-603 5-1/4", Dual	115
M05-203-601 5-1/4", Offset	130
M05-203-602 5-1/4", Centered	130
Rack Adapter for 4250A, 4265A, 4270A, 4275A	
M05-205-600 51/4"	95
Rack Slides for M05-200-603 or M05-205-600	
M00-260-610 18"	130
M00-270-610 20"	130
M00-280-610 24"	130
A4200 Manual Control Unit w/Cable	700
4210A-4014 PCB Extender Board	100
4270A-4303 PCB Extender Cable	205
Y8021 1m Cable, for IEEE-488 bus	130
Y8022 2m Cable, for IEEE-488 bus	145
Y8023 4m Cable, for IEEE-488 bus	155

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

4200 Series Option Compatibility

Option	Description	4210A	4216A	4250A	4265A	4270A	4275A
42**A-01	Isolated Control Logic	1	1	1	1	1	1
42**A-03	External Reference	•	•	•	•	•	•
42**A-05	Interface for IEEE-488 Bus	1	1	1	1	1	1
42**A-06	Programmable Current Limit	–	–	2	•	2	•
42**A-07	100 Microvolt Resolution	•	–	2	–	2	–
42**A-09	Multistrobe Logic (BCD/Binary)	1	1	1	1	1	1
Other Items							
M05-205-600	Rack Adapter	–	–	•	•	•	•
M05-203-601	Rack Adapter, left or right side	•	•	–	–	–	–
M05-203-602	Rack Adapter, centered	•	•	–	–	–	–
M05-200-603	Rack Adapter, dual, left & right	•	•	–	–	–	–
M00-260-610	18-Inch Rack Slides	3	3	3	3	3	3
M00-270-610	20-Inch Rack Slides	3	3	3	3	3	3
M00-280-610	24-Inch Rack Slides	3	3	3	3	3	3

Notes: All options are customer-installable. However, add the suffix letter K if option is not to be installed at the factory. Order -07K and/or -09K through the parts department.
•Compatible option
1. -01, -05, or -09 is required. Only one may be installed in one instrument
2. Option -06 and -07 cannot be installed in the same instrument
3. Used with Rack Adapter -600 or -603
*42**A Use appropriate model number as prefix for option number*

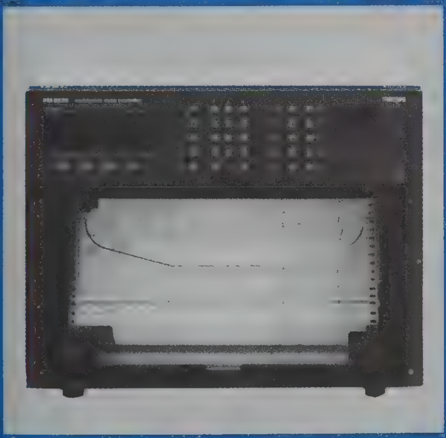
Data Acquisition

Page 399 2280B

Page 405 Helios-I

Page 415 1752A

Page 419 2452MCS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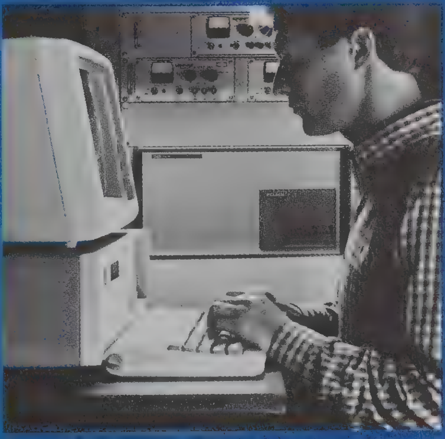
Page 401 Data Acquisition Software

Whether you need a complete system or an OEM component, Fluke has a reliable measurement and control solution. Aids like industry standard communications, software tools, and PC-compatible analysis packages make our data acquisition equipment simple to set up, integrate and use.

Our 1752A Data Acquisiton System, with powerful real-time processing, is Fluke's highest-speed system for manufacturing and product testing.

Helios-I Computer Front End and application software team up for a complete PC-based system. Menu-promoted setup eliminates the need for programming. Integration with Lotus 1-2-3™ helps you present a clear picture of your test results.

The 2400B Intelligent Computer Front End conditions over two dozen signal types, and frees your host computer from time-consuming monitoring and control tasks.

The 2452MCS Measurement and Control System is Fluke's most powerful data acquisition solution for a wide variety of tests and processes. It provides the user with the computing power of the 1752A and monitoring and control of the 2400B.

The 2280 SERIES Data Loggers feature menu prompted set-up, totally eliminating software programming. They support a full range of analog and digital options.

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Data Loggers 399
Computer Front Ends 405
Data Acquisition System & Software 415
Recorders 423

Selection Guide

Measurement	2285B	2280B	1752A	2400B*	2452MCS	HELIOS-I*	PM 8238*††
Thermocouples	11 Types	11 Types	7 Types**	12 Types	12 Types	11 Types	11 Types
RTDs	All Types	All Types	100Ω Pt. 385**	All Types	All Types	All Types	100Ω Pt
Resistance	To 64K	To 64K	–	To 64K	To 64K	To 64K	To 3.9K
DC Voltage Ranges	64 mV-64V	64 mV-64V	1V-10V	100 mV-100V	100 mV-100V	64 mV-64V	30mV-30V
Max DC Resolution	1 µV	1 µV	124 µV	1 µV	1 µV	0.5 µV	1 µV
AC Voltage Ranges	250V	250V	250V**	250V	250V	250V	–
DC Current	0 to 64 mA	0 to 64 mA	0 to 65 mA	0 to 20 mA	0 to 20 mA	0 to 64 mA	–
Strain Gage	Yes	Yes	Yes**	Yes	Yes	Yes	–
BCD	Yes	Yes	Yes	Yes	Yes	Yes	–
Binary	Yes	Yes	Yes	Yes	Yes	Yes	–
Status (Contacts)	Yes	Yes	Yes	Yes	Yes	Yes	–
Counter	To 1 kHz	To 400 kHz	To 900 kHz	To 900 kHz	To 900 kHz	To 400 kHz	–
Event Totalize	Yes	Yes	Yes	Yes	Yes	Yes	–
Sequence of Events	–	–	–	Yes	Yes	–	–
Control							
Status or Alarms	0-100	0-1500	0-256	0-1024	0-1024	0-1500	0-32
Int Relays (Max)	1	1	–	0-1024	0-1024	–	32
User-Defined BCD	Yes	Yes	Yes	Yes	Yes	Yes	–
Analog Voltage	–	To ±10V	To ±10V	To ±10V	To ±10V	To ±10V	–
Analog Current	–	4-20 mA	4-20 mA	4-20 mA	4-20 mA	4-20 mA	–
Analog Resistance	–	–	–	To 102K	To 102K	–	–
PID	–	–	Yes	Yes	Yes	Yes	–
Stepper Motor	–	–	–	Yes	Yes	–	–
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**Also requires host computer such as Fluke 1722A, 1752A or IBM PC (IBM is a registered trademark of Interntional Business Machines, Inc.)*
***Using external signal conditioning*

Features

Features	2285B	2280B	1752A	2400B*	2452MCS	HELIOS-I*	PM 8238*††
Basic Accuracy (dc V)	±.005%	±.005%	±.02%	±.002%	±.002%	±.005%	±0.1%
Speed Channels/s	15	15†	1000†	25	25 (High Res) 1000 (Med Res)	16†	10
Programming Environment	Menu Prompted	Menu Prompted	BASIC FORTRAN Assembly C	Fluke Measurement & Control Language	BASIC FORTRAN Assembly Pro Gen & C	Dependent on Host	Function Keys + Six Digit Display
Operator Interface	Membrane Keypad	Membrane Keypad	Touch-Screen	Via Host	Touch-Screen	Via Host	4 Digit Display + Functional LEDs
Analog Input Channels	100	1500	128	1000	128	1500	
RS-232/IEEE-488	Opt	Opt	Std	Opt	Std	RS-232-C Std	Opt
12V dc Operation	Yes	Yes	Opt	–	Opt	Opt	–
Memory Expansion	None	None	3.0M + Bytes	None	3.0M + Bytes	–	–
Graphics	Plot	Plot	Dot Address	Via Host	Dot Address	Via Host	1000 Point Chart Recording
Permanent Data Storage	Host	Cartridge	Disk Non-Volatile RAM	Eprom Host	Disk Non-Volatile RAM	Host	Hard Copy
Built-in Printer	Yes	Yes	–	–	–	–	Yes
Battery Back-up	Program, Clock	Program, Clock	Clock	None	Clock	Definitions, Clock	Program, Clock
Software for IBM PC	Yes	Yes	–	Yes	–	Yes	Yes
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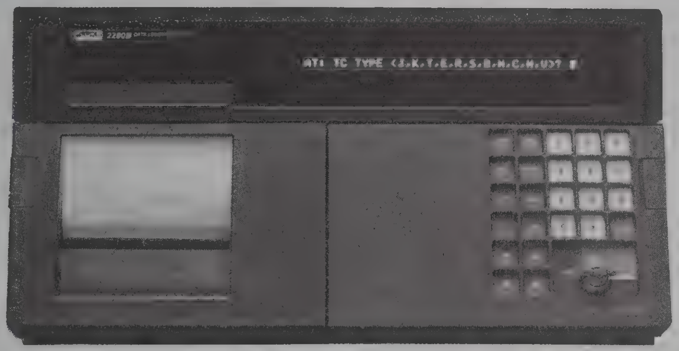
†Higher speeds possible with Multiple A/D Converters
††Specifications also applicable to KS 8238

2280 Series

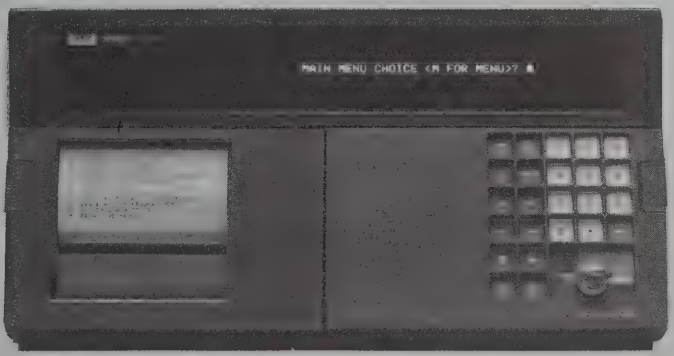
GPIB
IEEE-488



2280B

2280B Data Logging System

- Fluke's most powerful data logger
- Expandable to 1500 channels*
- Precision measurements and control
- Flexible report generation
- 12V operation for mobile or field use
- Pseudo-channels give computer power without writing software



2285B

2285B Data Logger

- Economical solution for simpler applications
- Expandable to 100 channels
- Precision measurements
- Flexible report generation
- 12V operation for mobile or field use
- Pseudo-channels give computer power without writing software

The 2280 SERIES, a family of advanced data loggers, combines high measurement accuracy, exceptional configurational flexibility, and computer-like power without requiring the user to write software. This family, composed of the 2285B Data Logger and the more powerful 2280B Data Logging System, offers solutions for demanding data acquisition and reporting problems.

The 2280B Data Logging System, Fluke's most powerful data logger, is expandable from a simple 20 channel data logger to a distributed 1500 point data acquisition system. The 2280B Data Logging System accepts all 2280 SERIES options, offers the ultimate in data logging power and flexibility.

For applications that do not require all the power or expansion capabilities of the 2280B Data Logging System, the 2285B Data Logger is a more economical solution. Expandable to 100 points, the 2285B accepts all 2280 SERIES options, except the Analog Output (-170), Counter/Totalizer (-167), Cartridge Tape (-214), and Advanced Math (-211) options.

Programming Ease

Both the 2285B and 2280B are programmed by responding to a series of prompted menus. Simple front panel responses to the displayed questions configure the 2280 SERIES to perform the required tasks. Instead of limiting the user to pre-defined functions, or requiring the development of libraries of application software, the 2280 SERIES employ pseudo-channels. An exclusive 2280 SERIES feature, pseudo- channels allow any mathematical relationship between channels, such as group averages; or between a channel and time, such as rate of change; to be described as a simple algebraic equation. With pseudo-channels, application problems that previously required the power of a computer, and an investment in software, are now possible in a stand-alone data logger.

Power to Get the Job Done

Accenting this computational power, the 2280 SERIES offer excellent documentation features. Each measurement channel, output channel or pseudo-channel can be uniquely identified with a 15 character label, clearly describing the point being logged. Adding further clarity, 6 character, user defined, engineering units for each point are a standard feature. Also standard is the ability to check every input, output or pseudo channel against alarm limits. Four high/low limits are available for each channel, and each limit can cause a user defined 40 character message describing the alarm condition to be recorded.

Report Generation

The 2280 SERIES allows its recording function to be easily tailored to the requirements of the job. Collected data, the results of calculations, or outputs can be viewed on the bright, 40 column

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**Depending on programming requirements.*

vacuum fluorescent display, or logged on the wide format 40 column internal printer. Adding further recording flexibility are two communication ports which can be configured with optional RS-232-C or GPIB/IEEE-488* interfaces. An optional DC100 magnetic tape drive is also available for the 2280B Data Logging System, allowing 500K bytes of data and/or programs to be saved on each tape. This stored data may later be downloaded to a PC using the Prologger Software Package.

For Demanding Environments

Applications that require more input or output points than can be housed in the mainframe are satisfied by using the 2281A extender chassis. These extender chassis are connected to the mainframe with a simple six twisted pair cable, and communicate via a high speed, fault tolerant, communication network. Since all communication is digital, signal integrity is assured in electrically noisy environments. Furthermore, any input or output options housed in an extender chassis have an operating range of -20°C to +70°C.

Portable Operation

Another standard feature is full operation from 12V dc power, making the 2280 SERIES a natural for mobile data acquisition. Additionally, connecting a 12V battery allows this dc operating mode to function as an uninterruptable power supply. The 2280 SERIES trickle charges the battery when on line power and bumplessly transfers to battery operation when line power fails, assuring measurement integrity for critical applications.

Specifications

2280 SERIES System

Maximum Inputs & Outputs: ≤1500 points per system (2280B); ≤100 points per system (2285B) Analog Inputs: ≤1500 channels per system (2280B), ≤100 channels per system (2285B)
Status, Binary, or BCD Inputs: ≤1500 lines per system (2280B), ≤100 lines per system (2285B)
Status Outputs: ≤1500 points per system (2280B); ≤100 points per system (2285B)
Alarm Outputs: ≤1500 points per system (2280B); ≤100 points per system (2285B)
Analog Outputs: ≤600 points per system (2280B only)
Computation Power: Besides built-in thermo couple and RTD linearizations, the 2280 SERIES will handle equations involving addition, subtraction, multiplication, division, and parentheses. Advanced Math Option (-211) (2280B only) adds square root, exponent, logarithm, trigonometric, standard deviation, interpolation tables, logic functions, equal-to, less-than, greater-than, etc.
Tasks: Up to 10 independent, prioritized scan groups
Scanning Speed: Depends on the number of A-to-D Converter Options (-161) per system and the system configuration. Scanning dc voltage inputs for alarms at full accuracy:
Up to **16** channels per second with **1** A/D Option
Up to **30** channels per second with **2** A/D Options
Up to **42** channels per second with **3** A/D Options
Up to **65** channels per second with **5** A/D Options
Temperature: 0°C to 50°C operating (2280B/2285B); -20°C to 70°C operating (2281A)
System Communications: High speed digital data transferred between 2281As and a 2280B/2285B is via noise-immune twisted wire-pairs. May be linked in star and/or daisy-chain configurations
Distance To Extender Chassis: Any 2281A may be up to 1 km away from a 2280B/2285B
Failures: System component failures are reported as an alarm. All properly operating equipment continues with normal tasks

2280 SERIES Mainframe

I/O Capacity: Six slots for input and output op tions. One of the six slots must contain an A-to-D converter option when one or more analog input options is used. Each analog input option will scan 20 channels and each status or digital input or output option will handle 20 lines. If no A-to-D converter option is needed, each 2280B/2285B will handle up to 120 points of status inputs or outputs. Two additional plug- in slots are for any combination of one or two IEEE-488 or RS-232 options
Program Memory: 32K bytes (2280B); 20K bytes (2285B). Non-volatile. Battery back-up for at least 30 days, 90 days typical. Program may also be printed using internal printer or with optional interface to external devices
Internal Printer: Uses thermosensitive paper, 110 mm (4.4 in) wide. Up to 40 alphanumeric characters per line printed from 5x7 dot matrix, 2.6 lines per cm (6.7 lines per in). Each line printed below the previous line. Will plot one to four graphs from scanned or calculated data, instead of alphanumeric characters, using distinctive symbol for each graph in any of 276 discrete positions across width of paper. Automatic paper take-up reel prevents spilling and allows withdrawal of any printed portion for review
Power: 100, 120, 220, or 240V ac ±10%, 50 or 60 Hz. Or 10.5 to 15V dc. Ac power will trickle-charge 12-volt battery for uninterrupted power. Less than 120W fully loaded
Included: Manual set, Getting Started Guide, one roll of printer paper, one pad of programming forms and power cord

2281A Extender Chassis

Capacity: Same plug-in options as 2280B/2285B
Power: Normally supplied by 2280B/2285B via 2281A-402 cable or equal. An optional built in power supply (2281A-431) may also be used and may be required for remote operation
Operating Temperature: -20°C to +70°C
Weight: 20-29 kg (45-66 lb) depending on configuration
Size: 22.23 cm H x 43.94 cm W x 66.17 cm D (9.35 in H x 17.30 in W x 26.05 in D)
Altitude: Operating: 3050 M (10,000 feet); non-operating: 12,200 M (40,000)

Options

DC 100 Tape Drive Option (-214) (2280B only)

Used to store both scanned data and data logger programs. A single tape can contain multiple files of programs and/or data as the operator chooses. The tape is formatted with a directory which may be listed on the printer.

Four data compression formats are selectable for data recorded. Storage capacity is 500K bytes which is 11,300 to 41,600 channel readings dependent upon format selection.

Recorded data may be transferred to the internal printer, peripheral devices, or a PC (See Prologger software page 403). The data transfer function permits data recorded at full speed to be transferred to a slower device such as the internal printer. The operator may transfer an entire file or part of a file based upon the time the data was recorded. For example, if a file contains data from a 24-hour test, the operator may only be interested in printing information gathered between 2:00 p.m. and 3:00 p.m. The operator enters these "start" and "stop" times and the 2280B searches for and transfers only those scans which were executed in the 2 to 3 p.m. time span.

One blank DC 100 tape cartridge is included with Option -214.

Advanced Math Option (-211) (2280B only)

Functions: Absolute value, square root, exponential, sine, cosine, tangent, arc sine, arc cosine, arc tangent, common logarithm, natural logarithm, e^x, exponentiation, integer part, maximum value, minimum value, standard deviation, elapsed time
Logical Operators: AND, OR, NOT, EXCLUSIVE OR
Relational Operators: <, ≤, >, >, =, ≠
Interpolation Tables: ≤10, user-entered. Number of points per table is limited only by system memory

High Performance A/D Converter Option (-161)

One per 2280B/2285B and 2281A required for any analog measurement inputs. ≤15 total per system

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Dynamic Range: 80,000 counts
Ranges: ±64 mV, ±512 mV, ±8V, and ±64V dc
Resolution: 1 µV on 64 mV range, 10 µV on 512 mV range, 100 µV on 8V range, 1 mV on 64V range
Common Mode Noise Rejection: ≥170 dB at 50 or 60 Hz ±0.1%; ≥160 dB at dc; 100 ohm unbalance
Normal Mode Noise Rejection: ≥60 dB at 50 or 60 Hz ±0.1%
Operating Temperature: -20°C to +70°C

2280B/2285B & 2281A Input Options

For These Inputs	Use Connector Option	With Scanner Option	Maximum Inputs Per Scanner
Thermo-couples	-175	-162**	20
DC Voltage	-176 or 175	-162**	20
DC Current	-171	-162**	20
AC & DC Voltage	-160	-162**	10 AC 10 DC
RTDs or Ohms	-177	-163**	20
RTDs, Ohms Strain	-174*	-164**	20
Status	-179	-168	20
BCD Digits	-179	-168	5
Binary	-179	-168	17 Bits & Sign
Frequency	-179	-167/AA	4
Frequency	None Req	-167	6 (2280B only)
Totalize Events	-179	-167/AA	4
Totalize Events	None Req	-167	6 (2280B only)

**A dc voltage scanner and companion connector Option (-162 and -176) are also required for each Transducer Excitation Option -164 used for RTDs, Ohms, or Strain measurements*
*** A/D Converter (-161) required in chassis*

Voltage, Thermocouple Inputs

Thermocouple and DC Scanner Option (-162)

Channels: Twenty per option. One 3-pole dry reed relay for each channel (Hi, Lo, Shield)
Ranges: 64 mV, 512 mV, 8V, and 64V, software-selectable
Input Impedance: ≥200 MΩ on 64 mV and 512 mV ranges, 10 MΩ on 8V, and 64 ranges
Thermal Offset: ≤1 µV each channel
Maximum Input Voltage: 250V dc or rms ac between Hi and Lo terminals
Maximum Common Mode Voltage: 250V dc or rms ac between Hi or Lo and ground or between two adjacent channels

Isothermal Input Connector Option (-175)

Channels: Twenty 3-wire sets of screw terminals for thermocouple or voltage input wires. Large, insulated aluminum block serves as reference junction
Maximum Measurable Voltage: 64V dc
Compatibility: Plugs onto scanner module, Option -162

Voltage Input Connector Option (-176)

Channels: Twenty 3-wire sets of screw terminals for dc voltage input wires
Maximum Measurable Voltage: 64V dc
Compatibility: Plugs onto scanner module, Option -162
DC Voltage Accuracy: ±(% of Rdg + Counts)*

Range	90 Days 15°C°C to 35°C	1 Year 15°C to 35°C	1 Year** -20°C to 70°C
64 mV	0.005% + 7	0.01% + 8	0.03% + 9
512 mV	0.005% + 3	0.01% + 4	0.03% + 5
8 mV	0.005% + 7	0.01% + 8	0.03% + 9
64V	0.009% + 3	0.02% + 4	0.05% + 5

**Total instrument accuracy using Option -162 and -176*
***A/D Converter must be in 2281A for operation to -20°C or 70°C*

Temperature Measurement Accuracy, Thermocouples

Thermocouples		Accuracy [1] [3]		
Type & Range °C	Temperature °C	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year [2] -20° to70°C
J	-100 to -25	0.45	0.5	0.8
-200 to 760	-25 to 760	0.35	0.4	0.7
K	0 to 900	0.4	0.45	0.7
-275 to 1350	900 to 1350	0.52	0.65	1.3
T	-100 to 75	0.58	0.65	1.1
-230 to 400	75 to 150	0.35	0.39	0.7
	150 to 400	0.3	0.34	0.6
E	-100 to -25	0.47	0.54	0.9
-250 to 900	-25 to 750	0.3	0.33	0.6
	750 to 900	0.33	0.4	0.8
R	250 to 450	0.9	1.0	1.3
0 to 1767	450 to 1767	0.8	0.9	1.4
S	200 to 1767	0.97	1.1	1.6
0 to 1767				
B	600 to 800	1.4	1.6	1.9
200 to 1820	800 to 1820	0.96	1.1	1.3
N [4]	-100 to 150	0.6	0.7	1.1
-200 to 400	150 to 400	0.4	0.44	0.7
C	200 to 1000	0.57	0.66	0.94
0 to 2315	1000 to 2000	0.90	1.2	2.1
	2000 to 2315	1.3	1.7	2.9
JDIN	-100 to -25	0.5	0.56	0.9
-200 to 900	-25 to 900	0.4	0.45	0.7
TDIN	0 to 200	0.48	0.53	0.8
-200 to 600	200 to 600	0.37	0.41	0.7

[1] Total instrument accuracy. Includes all instrument errors such as A/D errors, scanner errors, power supply warm-up, reference junction errors, conformity errors, etc.
[2] Total instrument accuracy using Option -162 and -175 in 2281A chassis.
[3] A/D Converter must be in 2281A for operation to -20°C or 70°C.
[4] For AWG 28 wire.

Current Input Connector Option (-171)

Channels: Twenty 2-wire pairs of screw terminals for current inputs. Typically for 4 to 20 mA or 10 to 50 mA inputs
Maximum Measurable Current: 64 mA per channel
Current-Sense Resistors: 8Ω ±0.02Ω
DC Current Accuracy: ±(0.25% of reading + 4 counts) for 90 days
Compatibility: Plugs onto scanner module, Option -162

AC Voltage Input Connector Option (-160)

Channels: Ten 2-wire sets of terminals for ac voltage and ten for dc voltage
Voltage Range for AC: 5V rms to 250V rms measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Frequency Range for AC: 45 Hz to 450 Hz
Accuracy for AC: 1% of reading ±0.1V for 90 days. Average-responding conversion; calibrated for rms value of sinewaves
Voltage Range for DC: 64V maximum measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Accuracy for DC: Same as for Option -162 with Option -176
Compatibility: Plugs onto scanner module, Option -162

RTDs & Ohms Scanner Option (-163)

A 20-channel scanner module for precision measurements of RTDs and/or resistances.
Measurement Modes: 4-wire or one of two 3-wire modes (both with lead-wire resistance compensation). One 3-wire mode eliminates reed resistance errors
Ranges: Three; 256Ω, 2048Ω and 64 kΩ (or user selectable), software programmed
Current Sources: Two; 1 mA and 32 µA (or user selectable)
Input Isolation: 250V dc or ac rms between separate scanner modules. 250V dc or ac rms between the two decades of channels within a scanner module. 250V dc or ac rms between all channels in two of the three measurement modes. 30V dc or 24V ac rms between terminals of a channel

RTDs & Ohms Connector Option (-177)

Plugs onto the Option -163 circuit card module. Contains five terminals per channel for 20 channels of RTD and resistance input wires.

RTD Specifications, Six Classes

A–User-defined high resolution Platinum RTDs
B–High resolution Platinum 385 DIN RTDs
C–User-defined high temperature Platinum RTDs
D–High temperature Platinum 385 DIN RTDs
E–Ten Ohm Copper RTDs, not grounded, electrically insulated
F–Ten Ohm Copper RTDs, grounded (special, consult factory)

RTD Class	Temperature	System		
		Resolution	Accuracy*	Repeatability*
A	-200 to +150°C +150 to +420°C	0.006°C 0.006°C	0.1°C** 0.15°C**	0.04°C** 0.04°C**
B	-200 to +150°C +150 to +420°C	0.006°C 0.006°C	0.10°C** 0.15°C**	0.04°C** 0.04°C**
C	-200 to +600°C	0.05°C	0.27°C***	0.16°C***
D	-200 to +600°C	0.05°C	0.28°C***	0.16°C***
E	-75 to +150°C	0.06°C	0.3°C**	0.17°C**
F	-75 to +150°C	0.06°C	1.25°C**	0.3°C**

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*
***RTD Temperature ≤150°C*
****RTD Temperature ≤600°C*
Note: Classes A and C allow the user to perform an ice point initialization and improve total system accuracy to be the sum of repeatability plus 0.03°C for 390 and 392 RTDs. The same procedure for a 385 DIN RTD yields total system accuracy to be the sum of repeatability plus 0.03°C plus the RTD probe conformity error.

Ohms Specifications Option (-163,-177)

Range	Resolution	±(% of Rdg + Ω)	
		Accuracy	Repeatability
256Ω	2.4 mΩ	0.017% + 5.7 mΩ	0.0065% + 5.7 mΩ
2048Ω	19 mΩ	0.017% ±38 mΩ	0.0060% ±38 mΩ
64 kΩ	0.6 mΩ	0.06% ±1.22Ω	0.0075% ±1.22Ω

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

RTDs, Ohms, & Strain Excitation Option (-164)

Five constant current sources for measuring RTDs and/or resistances and a constant voltage source for measuring strain. Channels are configurable in groups of four for either voltage or current excitation. These current sources are factory configured for 1 mA output and are user-modifiable for other ranges. The voltage supply is switch-selectable for either 2V or 4V and can supply up to 250 mA. A bridge completion network is provided for 1/2- and 1/4-bridge strain gages. Requires Connector Option -174. Option -174 and -164 plug together and occupy one I/O slot in Helios-I or 2281A, usually adjacent to the corresponding Scanner Option -162, which is also required.

RTDs, Ohms, & Strain Connector Option (-174)

Channels: Twenty 5-wire sets of screw terminals for connections to RTDs or strain gages. Terminals also provide access to the bridge completion network of Option -164
Compatibility: Plugs onto excitation module, Option -164

Ohms Mode Specifications Option (-164, -174)

Max Resistance	Accuracy* ±(% of Rdg + mΩ)	Resolution	Excitation Current
64Ω 512Ω	0.02% + 7 0.02% + 30	1 mΩ 10 mΩ	1 mA 1 mA
Other ranges that may be set by user			
5.12 kΩ 51.2 kÛ	Depends on user's resistor	0.1Ω 1Ω	0.1 mA 0.01 mA

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

RTD Mode Specifications Option (-164, -174)

RTD channel definitions allow you to tailor the instrument to the known characteristics of your probe with a conformity error less than 0.05°C
Resolution: 0.02°C
Temperature Measurement Accuracy*

RTD Type & Range	Maximum Instrument Error
100Ω Platinum RTDs	
-200°C to +200°C 200°C to 600°C	0.1°C 0.15°C
10Ω Copper RTDs	
-75°C to +150°C	1.0°C

**Total Instrument Accuracy, 13°C to 33°C for 90 days.*

Repeatability: ±0.08°C for Platinum RTDs, ±0.2°C for Copper RTDs
Temperature Coefficient: ±10 ppm/°C

Strain Mode Specifications Option (-164, -174)

Full-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges with 2V supply or ten 120Ω bridges with 4V supply
Resolution: 0.25 microstrain
Total System Accuracy: ±(0.05% of rdg + 2 microstrain)*
Temperature Coefficient: ±10 ppm/°C
1/2-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 13 microstrain)*
Temperature Coefficient: ±15 ppm/°C
1/4-Bridge Strain
Capacity: Twenty bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 25 microstrain)*
Temperature Coefficient: ±20 ppm/°C
**20°C to 30°C for 90 days*

Frequency Measurement and Event Totalization (-167) (2280B only)

Channels: Six
Functions: Event counting and frequency measurement, selectable per channel pair

Inputs
Signal Types: TTL, CMOS, contacts, analog waveforms
Adjustments: Threshold, deadband, and debouncing
Isolation: Each group of six channels isolated from ground
Frequency Measurement: 400 kHz maximum frequency, 0.001% resolution

Event Counting
Maximum Counts: 8,388,607
Counting Rate: DC to 400 kHz
Operation: Count is reset after each scan
Connector: Screw terminal connector supplied

Frequency Measurement and Event Totalization (-167/AA)

Channels: Four
Functions: Event counting and frequency, selectable by channel

Inputs
Signal Types: TTL or contacts
Adjustments: None
Isolation: Each group of four channels isolated from ground
Frequency Measurement: 1000 kHz maximum frequency, 1 Hz resolution

Event Counting
Maximum Counts: 65,534
Operation: Count is reset after each scan. Pseudo channels are used for count accumulation
Counting Rate: DC to 1000 kHz
Connector: Uses -179 Digital/Status Input Connector (not supplied)

Digital & Status Inputs & Outputs

Digital Input/Output Module Option (-168)

For controlling up to 20 input or output lines. Handles either 20 status inputs, 5 groups of 4-wire BCD digit inputs, or one 17-bit binary number (and sign). Or handles 20 status outputs. Inputs: Zero volts or contact closures for low, +6 volts maximum for high
Common Mode Voltage: 30V rms ac or dc, maximum
Outputs: Open collector NPN transistors, diode clamped, 28V maximum, 100 mA at 1V
Compatibility: Requires connector Option -179 for inputs or connector Option -169 for outputs

Digital/Status Input Connector Option (-179)

Channels: Twenty 2-wire pairs of terminals for Option -168 plus terminals to select BCD and binary clocking format

Status Output Connector Option (-169)

Channels: Twenty 2-wire pairs of terminals for Option -168. Also terminal provided for clamp ing diodes when used to drive relays

Analog Output

Analog Output Option (-170) (2280B only)

Outputs: Four per module. Each output has a selectable choice of mode: -5V to +5V, 0V to +10V, or 4 to 20 mA
Resolution: 2.44 mV in voltage range, 3.9 µA in current range
Accuracy: ±0.1% of range for 90 days, 15°C to 35°C (
Isolation: Each group of four channels isolated from ground
Compliance Current: 5 mA in voltage mode
Compliance Voltage: 10V in current mode
Temperature Range: -20°C to +70°C, operating in 2281A
Connector: Included with option

Other 2280 SERIES Options

RS-232-C Interface Option (-341)

Data may be output via the RS-232-C interface at 110 to 19,200 baud, selectable from the front panel. May be configured to operatoe on a 20 mA current loop and can serve as the 20 mA current source.

Other RS-232-C parameters selected via the front panel include: Data compression format, channel readings per line, start of data sequence, end of data dwquence, line termination sequence, and parity.

Acts as a erminal (DTE) or, with an included adapter, as a modem (DCE), or both (with two Options).
Baud: 110, 300, 600, 1200, 4800, 9600, or 19,200
Parity: Odd, even, or neither

Option -341 includes a Y1707 2-meter cable and a Y1705 null modem cable.

IEEE-488 Interface Option (-342)

Operates as either a talker only, or talker/listener. Easy-to-read thumbwheel switches are used to set the IEEE-488 address and are accesible from the rear panel. Data output parameters selected from the front panel include data compression format and the number of channel readings per line.
Repertoire in Port A: SH1, AH1, T5, L4, SR1, RL1, DC1, E2
Repertoire in Port B: SH1, AH1, T5, L4, SR1 and E2

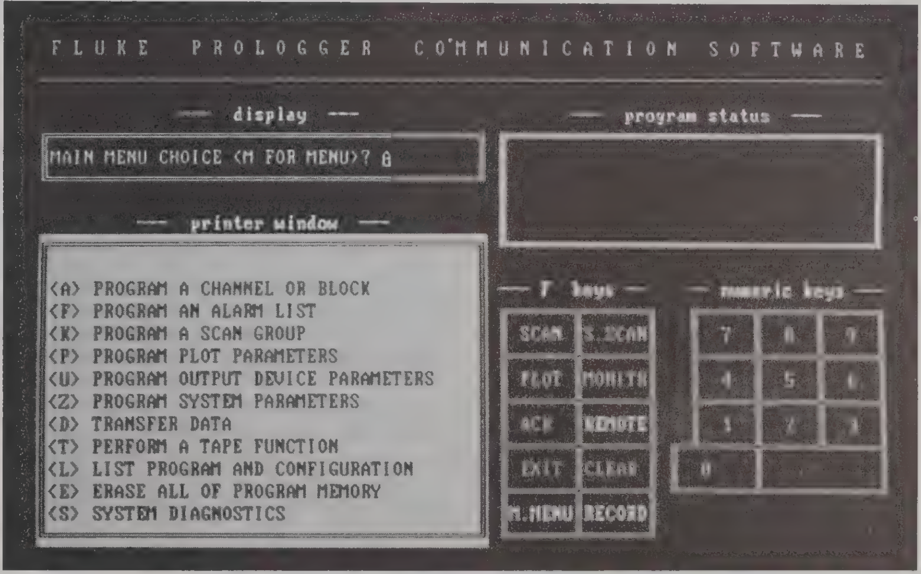
Order Y8021, Y8022, or Y8023 IEEE-488 cables separately.

2281A Power Supply Option (-431)

Although power for a 2281A is normally supplied by a 2280B/2285B via a2281A-402 Cable, a built in power supply Option (2281A-431) is available and is required when the distance to a 2281A and/or the current drain of the 2281A is heavy because of the number of options installed. The 2281A-431 power supply will operate on ac power or a 12V or 24V dc supply, either of which will trickle charge a 12V battery for battery. backup in the event of a power failure. Ask your Fluke Sales Office or Representative for Configuraqtion Form F605 to determine what options may be installed in a 2281A at what distances without Option 2281A-431.
Operating Temperature: -20°C to + 70°C

2280 SERIES Accessory Descriptions

Y2042: Package of five DC 100 tape catridges certified for use with Tape Drive Unit (Option -214)
Y2044: Rack Slide Kit for mounting 2280 SERIES or 2281A in a standard 42 cm (19 inch) rack with 61 cm (24 inch) depth. Contains all necessary hardware including a Y2045. Height is 22.2 cm (8.75 in).
Y2045: A rack mounting kit for 2280 SERIES or 2281A. Does not include rack slides. Fits standard 42 cm (19 inch) rack with 61 cm (24 inch) depth. Height is 22.2 cm (8.75 in).
Y2046: Package of ten rolls of thermal print paper for 2280B/2285B's printer/plotter. Capacity is 4000 lines of print, 12,000 channel readings using compressed mode.
Y2047: Three-connector device needed for "star" configurations.
A22-300: A heavy-duty transist case constructed from high-density polyethylene specifically for the 2280B/2285B. Foam Padding, cut to conform to the 2280A/2285B mainframe, insultates the data logger from shock encountered in shipping. Dimensions: 30.5 cm H x 64 cm W x 76.8 cm D (12 in x 25.1 in x 30.1 in).



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FLUKE PROLOGGER COMMUNICATION SOFTWARE

MAIN MENU CHOICE <M FOR MENU>? A

<A> PROGRAM A CHANNEL OR BLOCK
<F> PROGRAM AN ALARM LIST
<K> PROGRAM A SCAN GROUP
<P> PROGRAM PLOT PARAMETERS
<U> PROGRAM OUTPUT DEVICE PARAMETERS
<Z> PROGRAM SYSTEM PARAMETERS
<D> TRANSFER DATA
<T> PERFORM A TAPE FUNCTION
<L> LIST PROGRAM AND CONFIGURATION
<E> ERASE ALL OF PROGRAM MEMORY
<S> SYSTEM DIAGNOSTICS
```

S2280 ProLogger Software

- For use with an IBM®-PC and the Fluke 2280 SERIES Data Loggers
- Accommodates full operation of the 2280B or 2285B from the IBM®-PC, XT, AT or compatibles
- Transfers data from the 2280 SERIES to disk in Lotus 1-2-3™ format

ProLogger Software is a tool which links the IBM-PC, XT, or AT with a Fluke 2280 SERIES Data Logger ot form a powerful data collection and analysis system. This package emulates the 2280 SERIES' front panel on the screen of the IBM,® and allows the user to program the data logger thgough the same menu prompting that is available on the 2280 SERIES itself. Other utilities allow the user to transfer data to a disk in Lotus 1-2-3™ format or ASCII, upload data from the 2280B;s option -214 Cartridge Tape Drive, download programs from disk on the IBM®-PC to the 2280 SERIES, and perform any other functions that can be accomplished from the 2280 SERIES' front panel.

The IBM®-PC must have a serial interface, graphics card, and MS-DOS 2.1 or higher. A color monitor is not a necessity, but will enhance the appearance of ProLogger. The IBM-PC needs 128k of lmemory, however. Lotus1-2-3™ will require additional memory. The 2280 SERIES Data Logger must have -341 RS-232-C Interface Option.

Ordering Information

Models

January 1989 prices

2280B Data Logging System	$7500
2285B Data Logger	5500
2281A Extender Chassis (1m Cable included)	850

Options

2280A-160 AC & DC Input Connector	295
2280A-161 High Performance A/D Converter	800
2280A-162 Thermocouple & DC Voltage Scanner	650
2280A-163 RTD & Ohms Scanner	995
2280A-164 RTD, Ohms, Strain Excitation	690
2280B-167 Counter/Totalizer, 6 Channel	950
2280A-167/AA Counter/Totalizer, 4 Channel	on req.
2280A-168 Digital or Status Input/Output	720
2280A-169 Status Output Connector	120
2280A-170 Analog Output	995
2280A-171 Current Input Connector	200
2280A-174 Transducer Excitation Connector	395
2280A-175 Isothermal Input Connector	$180
2280A-176 DC Voltage Input Connector	100
2280A-177 RTD, Ohms, Connector	210
2280A-179 Digital/Status Input Connector	100
2280A-211* Advanced Math Processor	1250
2280A-214* DC 100 Tape Drive Unit	1900
2280A-341 RS-232 Interface	990
2280A-342 IEEE-488 Interface	990
2280A-402 Connecting Cable (per meter)	5
2281A-403 Connectors for Option -402	95
2281A-431 Power Supply for 2281A	530

**Factory of Service Center installation only. Others user-installable*

Accessories (Also see page 485)

Y2042 Pack of 5 DC 100 Cartridges	130
Y2044 Rack Slide Kit and Rack Mount Kit	195
Y2045 Rack Mount Kit	150
Y2046 Rack of 10 Rolls Printer Paper	50
Y2047 Extender Chassis Multi-Connector	75
A22-300 Transit Case for 2280A	on req.
S2280 ProLogger Software	295

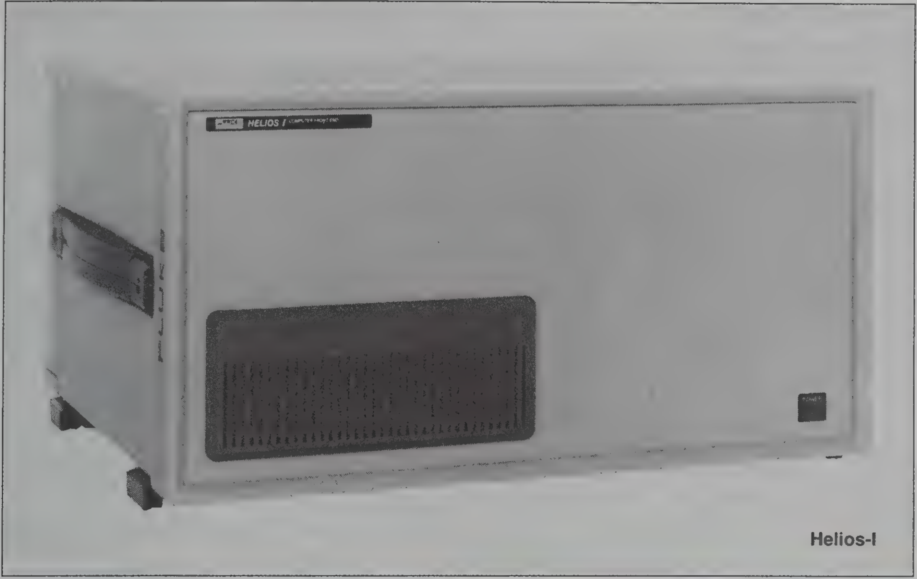
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2280B Repair (w/calibration)	$555
SC1-2280B Repair (cal w/in or out data)	590
SC1-2280B Repair (cal w/in and out data)	625
SC2-2280B Cal (1 per yr recommended)	126
SC2-2280B Cal (1 per yr w/in or out data)	161
SC2-2280B Cal (1 per yr w/in & out data)	196
SC1-2285B Repair (w/calibration)	526
SC1-2285B Repair (cal w/in or out data)	561
SC1-2285B Repair (cal w/in and out data)	596
SC2-2285B Cal (1 per yr recommended)	94
SC2-2285B Cal (1 per yr w/in or out data)	129
SC2-2285B Cal (1 per yr w/in & out data)	164
SC1-2281A Repair (w/calibration)	226
SC1-2281A Repair (cal w/in or out data)	261
SC1-2281A Repair (cal w/in and out data)	296
SC2-2281A Cal (1 per yr recommended)	94
SC2-2281A Cal (1 per yr w/in or out data)	129
SC2-2281A Cal (1 per yr w/in & out data)	164



Helios-I

Helios-I Computer Front End

- Wide range of measurement and control options
- Eliminates hardware integration problems
- Simple and powerful commands
- Application software available for a complete system
- Ruggedized dc powered version for mobile testing

Performance

You can use Helios-I to add high performance measurement capability to any of your computers, from lap-top to mainframe. Helios-I uses the same data acquisition and control options as the Fluke 2280 Series. These options have been proven in thousands of applications world-wide.

Helios-I gives your computer the power to read:

- Voltage
- Frequency
- Temperature
- Flow
- Strain
- Pressure
- Speed
- Many, many more...

The high performance Analog to Digital Con verter, in conjunction with data conversion capabilities built into Helios-I, means unsurpassed resolution, repeatability and accuracy in thermocouple, RTD and strain gage measurements.

These proprietary algorithms are both highly efficient and very accurate. They are optimized for Helios-I hardware giving performance that would be hard to match if host computer routines were required.

Independent Operation

The Scan/Alarm Option (2289A-201) adds autonomous capability to Helios-I. Scan/Alarm allows routine data acquisition tasks to be performed by Helios-I, reducing the load on the host comuter and the communications link. This results in a more efficient data acquisition system for remote applications or anytime it is useful to partition tasks between the host computer and the data acquisition front end.

With the Scan/Alarm Option Helios-I will scan measurement points and store up to 18,000 readings for later access by the compu ter. The Scan/Alarm Option also adds limit checking, alarm output, and alarm acknowledge.

Additionally, SCAN/Alarm provides a second RS-232C port for use with a local peripheral such as a printer, terminal, or mass storage device. Data sent to this port may be sent continuously, on time interval, or only on alarm.

Hardware Configuration

You can configure Helios-I to tailor it to your exact needs. One Helios-I mainframe can house up to 6 I/O modules, each with 20 channels. Communication with the I/O modules is by means of a high speed serial link.

A wide range of I/O modules is available. Several are multifunctional, providing configuration flexibility and cost savings when an application requires a range of input and output types.

Extended Systems

Remote expansion chassis are available to bring the total configuration to 1500 channels. The distance between an extender chassis and the mainframe may be up to 1200 meters. Connections may be made in daisy chain, star and maze configurations so that cable routing can easily be adapted to the physical layout of your facility.

Multiple Helios-I mainframes may be arranged in a multidrop configuration. This allows you to address up to 10 Helios-I units on a serial link.

Application Software

CIMPAC Software (2289A-902)

Fluke and Action Instruments have joined efforts in producing system combining CIMPAC DataAcquisition and Control software and Helios-I. the resulting system allows monitoring, recording, and controlling of factory installations or processes from an IBM PC/XT/AT or compatible without the need for programming. All system functions are configured through an easy-to-use menu system accessed through one-touch function keys.

GRAPHICS: CIMPAC has extensive EGA graphics capabilities for creation of pictorial presentations to simplify operator interpretation of data. The pictures may be animated with movement and color changes tied to real time operating variable. So, for example, changes in temperature or alarm level transitions can be clearly communicated to the user.

SPQ/SQC: CIMPAC allows users to monitor and control changing tolerance parameters in real time. Special statistical registers allow CIMPAC users to conveniently store point readings and access standard deviation and averaging data for graphical display, logging, or process control.

NETWORKING: COMPAC may be run on a single PC or networked to up to eight nodes (pc's) via a simple twisted pair RS-485 communications link running at 1 megabit per second. In this real-time network, each node broadcasts its own point readings to the other stations so that users may monitor and control any point from any node, as if all stations were one. Capability is avaiable for easily uploading information to a supervisory micro or mini computer outside the network.

LabTech NotebookSoftware (S2290)

Fluke and Laboratory Technologies Corp. have teamed up to create a complete system for data acquisition. LABTECH Note book® transforms the IBM® PC, XT or AT and compatibles along with Helios-I into a powerful data acquisition, analysis and real-time display system and no programming is required.

Data generated using Helios-I and LABTECH Notebook® is recorded in formats compatible with major analysis, spreadsheet and database programs. These include LOTUS 1-2-3,® Sym phony,® RS/1® and NWAStatpak.®

A menu driven format makes the operator interface easy to learn and to use. Complicated procedures can be reduced to single button operations. The result for you is fast system setup and increased efficiency in operation. Once the measurement and control activities are defined they can be stored on disk for easy recall.

Data acquisition can be started immediately or triggered externally. Data can be time stamped with either time of day or relative time.

LABTECH Notebook® allows other PC programs to be run concurrently. LABTECH Notebook® can perform data acquisition and control in the background while another program operates in the foreground. Your efficiency is increased considerably especially during long tests.

Helios Toolbox for BASIC Programmers (2289A-901)

Helios Toolbox is intended for the data acquisition system builder. It is a set of subroutines designed to provide building blocks for a complete system software package. By providing fully debugged and tested routines of common, and some not so common, system software tasks, software costs can be drastically reduced. The primary purpose of Helios Toolbox is to handle all communications between the host computer and Helios-I. To accomplish this Helios Toolbox provides routines to:

- Establish the communication channel.
- Define the Helios-I hardware configuration.
- Scan measurement points and read individual channels.
- Set status and analog outputs.
- Utilities that translate error codes, clear communication buffers, control Helios-I self tests.
- Log data directly into Lotus 1-2-3 worksheet file

Sources are provided for translation or user modification.

Prologger_HCL

Prologger_HCL is a communications utility for the IBM Personal Computer and the Fluke Helios Computer Front End. This software tool establishes serial communication with Helios-I and links Helios-I and the IBM to provide data acquisition capability for the IBM. Extensive use of IBM function keys provide an easy to use package.

This software package provides an environment in which you can record data from Helios-I in LOTUS 1-2-3 format, log data to a printer, create and save definitions and Macros on disk, graph in real time a selected Helios-I parameter and remotely control Helios-I.

Prologger_HCL includes a diskette and manual. Prologger_HCL is compatible with MS-DOS™ version 2.1 and above.

Helios-I is a trademark of John Fluke Mfg. Co., Inc. LABTECH is a registered trademark of Laboratory Technologies Corporation; IBM is a registered trademark of International Business Machine Corporation; Lotus 1-2-3 and Symphony are trademarks of Lotus Development Corporation; RS/1 is a trademark of BBN Software Products Company; NWAStatpak is a trademark of Northwest Analytical, Inc.

Command Set

If you desire to configure Helios-I with your own host computer software, Helios-I provides an environment that makes this interaction easy to create.

The Helios-I Operating System (HOS) resides in ROM together with the Helios-I Command Line Interpreter (HCLI). HOS takes care of task scheduling and contains driver software to control the functioning of the hardware. HCLI analyses the commands and translates them into appropriate actions.

Only six types of commands are necessary to control a standard Helios-I. Each has various parameters to change the scope of operation giving a command set that is conceptually easy yet powerful.

ASSIGNMENT: Assigns a value to a system variable or output channel.

DEFINITION: Identifies the type of sensors connected to Helios-I and if desired interpolation tables for each sensor.

LIST: Returns to the host computer channel definitions and user defined interpolation tables and errors detected by Helios.

RESET: Resets system or specified channels to power up state.

SEND: Returns data to host computer.

TEST: Tests all or part of the system and reports any detected problems.

DC Powered Helios-I (2289A/AA)

The 2289A/AA is a special ruggedized version of Helios-I designed for mobile testing and remote data gathering. It is powered from either a 12 or 24Vdc supply (8 - 18 or 21 - 28 Vdc respectively) and has an extended operating temperature range to +70 degrees C.

Specifications

Helios-I Mainframe (2289A)

The Helios-I mainframe is a cardcage unit that includes a CPU, power supply, RS-232 and RS-422 interfaces.

Controller

CPU: TMS-9995, 16 bit, 12 MHz clockrate
Memory: 40K bytes ROM, 72K bytes non-volatile RAM
Clock/Calendar: Accuracy 0.003% or 2.6 seconds/day at 25°C; battery backed
Battery Back-Up: 90 days typical, 30 days minimum
Interface: On-board command interpreter for high level instructions

Interfaces

Type: RS-232 or RS-422; asynchronous; selectable baud rate, parity, character bits and stop bits
Protocol: XON/XOFF or none; terminal or computer mode
RS-232: Compatible with auto-answer, full duplex modems; automatic hang-up
RS-422: Allows operation at extended distances from the host computer; allows point to point or multidrop configurations
Capacity: Six slots for input and output options. One of the six slots must contain an A to D Converter option when one or more analog input options is used. Each analog input option accomodates 20 channels so that up to 100 channels per chassis is available. Each digital I/O option accomodates 20 channels so that up to 120 channels per chassis is available.
Power: 90-132V ac or 180-264V ac; 47-440 Hz; less than 40W
EMI and RFI Emissions: Tested to FCC part 15, Subpart J, Class A; VDE 0871, Class B
Operating Temperature: 0°C to 50°C
Storage Temperature: -40°C to 70°C
Relative Humidity: (without condensation) below 25°C, <95%; 25°C to 40°C, <75%; 40°C to 50°C, <45%
Altitude: 12 km (40,000 ft), non-operating; 3 km (10,000 ft), operating
Shock and Vibration: Meets MIL-T-28800C, Class 5, Style F Standard
Weight: 8.5 kg (18.7 lb) without options
Size: 23.8 cm H x 43.9 cm W x 35.9 cm D (9.35 in H x 17.3 in W x 14.13 in D), (8.75 in H without feet)

2281A Extender Chassis

Capacity: Same as mainframe. Multiple extender chassis allow up to 1500 channels.
Power: Normally supplied by Helios-I via 2281A-402 cable or equal. An optional built-in power supply, 2281A-431, may also be used and may be required for some configurations.
Operating Temperature: -20°C to +70°C

Options

Scan/Alarm Option (-201)

Scanning
Number of Groups: 4
Trigger Mode: Time interval
Data Buffers
Number of Buffers: 4
Size: User defined
Format: Each scan record includes time stamp and channel status
Limit Checking
Number: 4 per channel, two high and two low
Alarm Hysteresis: User selected
Master Alarm Annunciation: Visual and audible
Master Alarm Acknowledge: Edge sensitive input for external pushbutton
Individual Alarm Output: Up to 20, one per channel (requires -168 Option)
Printer Port
Type: RS-232C
Connector: Pins (DTE)
Selectable: Baud, parity, data bits, stop bits

Measurement and Output Selection Guide

	Connector	Scanner	Channels	Max Chan/ Chassis
Thermocouple	175	-162^1	20	100
Direct Voltage	-175 or -176	-162^1	20	100
Direct Current	-171	-162^1	20	100
Alternating Voltage	-160	-162^1	10 ch. V≃ 10 ch. V≃	50 ch. V~ 50 ch. V~
RTD	-177	-163^1	20	100
RTD	-174	-164$^{1\ 2}$	20	40
Resistance	-177	-163^1	20	100
Resistance	-174	-164$^{1, 2}$	20	40
Strain Gage	-174	-164$^{1, 2}$	20	40
Frequency/Event Counting	Included	-167	6	36
Status Input	-179	-168	20	120
Binary Input	-179	-168	1	6
BCD Input	-179	-168	1	6
Status Output	-169	-168	20	120
Analog Output	Included	-170	4	24

[1] *A/D Converter (-161) required in each chassis*

[2] *A dc voltage scanner and companion connector Option (-162 and -176) are also required for each Transducer Excitation Option -164 used for RTDs, Ohms, or Strain measurements*

Host Timer
Interval: User defined
Timeout Result: All alarm information sent to printer port

High Performance A/D Converter Option (-161)

One per 2289A and 2281A required for any analog measurement inputs.
Dynamic Range: 100,000 counts
Ranges: ±64 mV, ±512 mV, ±8V, and ±64V dc
Resolution Using DC Scanner Option: 1 µV on 64 mV range, 10 µV on 512 mV range, 100 µV on 8V range, 1 mV on 64V range
Common Mode Noise Rejection: 2170 dB at 50 or 60 Hz ±0.1%; 2160 dB at dc; 100 ohm unbalance
Normal Mode Noise Rejection: 260 dB at 50 or 60 Hz ±0.1%
Operating Temperature: -20°C to 70°C
**Maximum capacity with -201 Option is 1000 channels*

Voltage, Thermocouple Current Inputs

AC Voltage Input Connector Option (-160)

Channels: Ten 2-wire sets of terminals for ac voltage and ten for dc voltage
Voltage Range for AC: 5V rms to 250V rms measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Frequency Range for AC: 45 Hz to 450 Hz
Accuracy for AC: 1% of reading ±0.1V for 90 days. Average-responding conversion; calibrated for rms value of sinewaves
Voltage Range for DC: 64V maximum measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Accuracy for DC: Same as for Option -162 with Option -176
Compatibility: Plugs onto scanner module, Option -162

Thermocouple and DC Scanner Option (-162)

Channels: Twenty per option. One 3-pole dry reed relay for each channel (Hi, Lo, Shield)
Ranges: 64 mV, 512 mV, 8V, and 64V, software-selectable
Input Impedance: ≥200 MΩ on 64 mV and 512 mV ranges, 10 MΩ on 8V, and 64 ranges
Thermal Offset: ≤1 µV each channel
Maximum Input Voltage: 250V dc or rms ac between Hi and Lo terminals
Maximum Common Mode Voltage: 250V dc or rms ac between Hi or Lo and ground or between two adjacent channels

RTDs, Ohms, & Strain Excitation Option (-164)

Five constant current sources for measuring RTDs and/or resistances and a constant voltage source for measuring strain. Channels are configurable in groups of four for either voltage or current excitation. These current sources are factory configured for 1 mA output and are user-modifiable for other ranges. The voltage supply is switch-selectable for either 2V or 4V and can supply up to 250 mA. A bridge completion network is provided for 1/2- and 1/4-bridge strain gages. Requires Connector Option -174. Option -174 and -164 plug together and occupy one I/O slot in Helios-I or 2281A, usually adjacent to the corresponding Scanner Option -162, which is also required.

RTDs, Ohms, & Strain Connector Option (-174)

Channels: Twenty 5-wire sets of screw terminals for connections to RTDs or strain gages. Terminals also provide access to the bridge completion network of Option -164
Compatibility: Plugs onto excitation module, Option -164

Ohms Mode Specifications (Option -164, -174)

Max Resistance	Accuracy* ±(% of Rdg + mΩ)	Reso- lution	Excitation Current
64Ω	0.02% + 7	1 mΩ	1 mA
512Ω	0.02% + 30	10 mΩ	1 mA

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

RTD Mode Specifications (Option -164, -174)

RTD channel definitions allow you to tailor the instrument to the known characteristics of your probe with a conformity error less than 0.05°C
Resolution: 0.02°C

Temperature Measurement Accuracy*

RTD Type & Range	Maximum Instrument Error
100Ω Platinum RTDs	
-200°C to +200°C	0.1°C
200°C to 600°C	0.15°C
10Ω Copper RTDs	
-75°C to +150°C	1.0°C

**Total Instrument Accuracy, 13°C to 33°C for 90 days.*

Repeatability: ±0.08°C for Platinum RTDs, ±0.2°C for Copper RTDs
Temperature Coefficient: ±10 ppm/°C

Strain Mode Specifications (Option -164, -174)

Full-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges with 2V supply or ten 120Ω bridges with 4V supply
Resolution: 0.25 microstrain
Total System Accuracy: ±(0.05% of rdg + 2 microstrain)*
Temperature Coefficient: ±10 ppm/°C

1/2-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 13 microstrain)*
Temperature Coefficient: ±15 ppm/°C

1/4-Bridge Strain
Capacity: Twenty bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 25 microstrain)*
Temperature Coefficient: ±20 ppm/°C
**20°C to 30°C for 90 days*

Helios-I (2289A)

Temperature Measurement Accuracy, Thermocouples

Thermocouples		Accuracy[1][3]		
Type & Range	Temperature °C	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year[2] -20°C to +70°C
J -200 to 760°C	-100 to -25 -25 to 760	0.45 0.35	0.5 0.4	0.8 0.7
K -275 to 1350°C	0 to 900 900 to 1350	0.4 0.52	0.45 0.65	0.7 1.3
T -230 to 400°C	-100 to 75 75 to 150 150 to 400	0.58 0.35 0.3	0.65 0.39 0.34	1.1 0.7 0.6
E -250 to 838°C	-100 to -25 -25 to 750 750 to 900	0.47 0.3 0.33	0.54 0.33 0.4	0.9 0.6 0.8
R 0 to 1767°C	250 to 450 450 to 1767	0.9 0.8	1.0 0.9	1.3 1.4
S 0 to 1767°C	200 to 1767	0.97	1.1	1.6
B 200 to 1820°C	600 to 800 800 to 1820	1.4 0.96	1.6 1.1	1.9 1.3
N[4] -200 to 400°C	-100 to 150 150 to 400	0.6 0.4	0.7 0.44	1.1 0.7
C 0 to 2315°C	200 to 1000 1000 to 2000 2000 to 2315	0.57 0.90 1.3	0.66 1.2 1.7	0.94 2.1 2.9
JDIN -200 to 900°C	-100 to -25 -25 to 900	0.5 0.4	0.56 0.45	0.9 0.7
TDIN -200 to 600°C	0 to 200 200 to 600	0.48 0.37	0.53 0.41	0.8 0.7

[1] *Total instrument accuracy. Includes all instrument errors such as A/D errors, scanner errors, power supply warm-up, reference junction errors, conformity errors, etc.*

[2] *Total instrument accuracy using Option -162 and -175 in 2281A chassis.*

[3] *A/D Converter must be in 2281A for operation to -20°C or 70°C.*

[4] *For AWG 28 wire.*

Current Input Connector Option (-171)

Channels: Twenty 2-wire pairs of screw terminals for current inputs. Typically for 4 to 20 mA or 10 to 50 mA inputs

Maximum Measurable Current: 64 mA per channel

Current-Sense Resistors: 8Ω ±0.02Ω

DC Current Accuracy: ±(0.25% of reading + 4 counts) for 90 days

Compatibility: Plugs onto scanner module, Option -162

Isothermal Input Connector Option (-175)

Channels: Twenty 3-wire sets of screw terminals for thermocouple or voltage input wires. Large, insulated aluminum block serves as reference junction

Maximum Measurable Voltage: 64V dc

Compatibility: Plugs onto scanner module, Option -162

RTDs & Ohms Connector Option (-177)

Plugs onto the Option -163 circuit card module. Contains five terminals per channel for 20 channels of RTD and resistance input wires. RTD Specifications, Six Classes

- **A** - User-defined high resolution Platinum RTDs
- **B** - High resolution Platinum 385 DIN RTDs
- **C** - User-defined high temperature Platinum RTDs
- **D** - High temperature Platinum 385 DIN RTDs
- **E** - Ten Ohm Copper RTDs, not grounded, electrically insulated
- **F** - Ten Ohm Copper RTDs, grounded (special, consult factory)

RTD Class	Temperature	System		
		Resolution	Accuracy*	Repeatability*
A, B	-200 to +150°C +150 to +420°C	0.006°C 0.006°C	0.1°C** 0.15°C**	0.04°C** 0.04°C**
C	-200 to +600°C	0.05°C	0.27°C***	0.16°C***
D	-200 to +600°C	0.05°C	0.28°C***	0.16°C***
E	- 75 to +150°C	0.06°C	0.3°C**	0.17°C**
F	- 75 to +150°C	0.06°C	1.25°C**	0.3°C**

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*
***RTD Temperature≤150°C*
****RTD Temperature ≤600°C*

Note: Classes A and C allow the user to perform an ice point initialization and improve total system accuracy to be the sum of repeatability plus 0.03°C for 390 and 392 RTDs. The same procedure for a 385 DIN RTD yields total system accuracy to be the sum of repeatability plus 0.03°C plus the RTD probe conformity error.

RTDs & Ohms Scanner Option (-163)

A 20-channel scanner module for prevision measurements of RTDs and/or resistances.

Measurement Modes: 4-wire or one of two 3-wire modes (both with lead-wire resistance companesion). One 3-wire mode eliminates reed resistance errors

Ranges: Three; 256Ω, 2048Ω and 64 kΩ (or user selectable), software programmed

Current Sources: Two; 1 mA and 32 µA (or user selectable)

Input Isolation: 250V dc or ac rms between separate scanner modules. 250V dc or ac rms between the two decades of channels within a scanner module. 250V dc or ac rms between all channels in two of the three measurement modes. 30V dc or 24V ac rms between terminals of a channel

Ohms Specifications Option (-163, -177)

Range	Resolution @ 60 Hz	±(% of Rdg + Ω)*	
		Accuracy	Repeatability
256Ω	2.4 mΩ	0.017% + 5.7 mΩ	0.0065% + 5.7 mΩ
2048Ω	19 mΩ	0.017% ±38 mΩ	0.0060% ±38 mΩ
64 kΩ	0.6 Ω	0.06% ±1.228	0.0075% ±1.228

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

Voltage Input Connector Option (-176)

Channels: Twenty 3-wire sets of screw terminals for dc voltage input wires

Maximum Measureable Voltage: 64V dc

Compatibility: Plugs onto scanner module, Option -162

DC Voltage Accuracy: ±(% of Rdg + Volts)*

Range	90 Days	1 Year	1 Year**
	15°C to 35°C		-20°C to +70°C
64mV	0.005%+7µV	0.01%+8µV	0.03%+9µV
512mV	0.005%+30	0.01%+40	0.03%+50
8mV	0.005%+700	0.01%+800	0.03%+900
64V	0.009%+3mV	0.02%+4mV	0.05%+5mV

** Total instrument accuracy using Option -162 and -176*
***A/D Converter must be in 2281A for operation to -20°C to 70°C*

Frequency Measurement and Event Totalization Option (-167)

Channels: Six
Functions: Event counting and frequency measurement, selectable per channel pair
Inputs
Signal Types: TTL, CMOS, contacts, analog waveforms
Adjustments: Threshold, deadband, and debouncing
Isolation: Each group of six channels isolated from ground
Frequency Measurement: 400 kHz maximum frequency, 0.001% resolution
Event Counting
Maximum Counts: 8,388,607
Counting Rate: DC to 400 kHz
Operation: Count is reset after each scan
Connector: Screw terminal connector supplied

Digital & Status Inputs & Outputs

Digital Input/Output Module Option (-168)

For controlling up to 20 input or output lines. Handles either 20 status inputs, (one 5-digit BCD input) or one 17-bit binary input, or handles 20 status outputs.
Inputs: Zero volts or contact closures for low, +6 volts maximum for high
Common Mode Voltage: 30V rms ac or dc, maximum
Outputs: Open collector NPN transistors, diode clamped, 28V maximum, 100 mA at 1V
Compatibility: Requires connector Option -179 for inputs or connector Option -169 for outputs

Digital/Status Input Connector Option (-179)

Channels: Twenty 2-wire pairs of terminals for Option -168 plus terminals to select BCD and binary clocking format

Status Output Connector Option (-169)

Channels: Twenty 2-wire pairs of terminals for Option -168. Also terminal provided for clamping diodes when used to drive relays

Analog Output Option (-170)

Outputs: Four per module. Each output has a selectable choice of mode: 0V to 10V, 4 to 20 mA, or 0 to 20 mA
Resolution: 2.44 mV in voltage range, 3.9 µA in 4 to 20 mA range, 4.8 µA in 0 to 20 mA range
Accuracy: ±0.1% of range for 90 days, 15°C to 35°C (calibrated on 0 to 10V range)*
Isolation: Each group of four channels isolated from ground and other channels up to 45V
Compliance Current in Voltage Mode: 5 mA sinking, 20 mA sourcing
Compliance Voltage in Current Mode: 10V
Temperature Range: -20°C to +70°C, operating in 2281A
Connector: Included with option

* *0.1% accuracy also obtainable on current ranges with recalibration. Current ranges have accuracy of ±0.25% when shipped from the factory*

2281A Power Supply Option (-431)

Although power for a 2281A Extender Chassis is normally supplied by a 2289A mainframe via a 2281A-402 Cable, a built in power supply Option (2281A-431) is available and is required when the distance to a 2281A and/or the current drain of the 2281A is heavy because of the number of options installed. The 2281A-431 power supply will operate on ac power or a 12V or 24V dc supply, either of which will trickle charge a 12V battery for battery backup in the event of a power failure. Ask your Fluke Sales Office or Representative for Configuration Form F605 to determine what options may be installed in a 2281A at what distances without Option 2281A-431.
Operating Temperature: -20°C to +70°C

Ordering Information

Models

January 1989 prices

2289A Helios-I Mainframe	$2300
2289A/AA Helios-I (dc powered)	on req
22810A Helios-I (including -161, -162 and -175)	3930
2281A Extender Chassis (1m cable included)	850

Hardware Options (for above Models)

-160 AC Voltage Connector	295
-161 High Peformance A/D Converter	800
-162 Thermocouple/DC Voltage Scanner	650
-163 RTD/Resistance Scanner	995
-164 Transducer Excitation Assembly	690
-167 Counter/Totalizer, w/connector	950
-168 Digital I/O Assembly	720
-169 Status Output Assembly w/connector	120
-170 Analog Output Assembly w/connector	995
-171 Current Input Assembly	$200
-174 Transducer Excitation Assembly	395
-175 Thermocouple Input Connector	180
-176 DC Voltage Connector	100
-177 RTD/Resistance Connector	210
-179 Digital/Status Connector	100
-201 Scan/Alarm Option	990
-402 Extender Chassis Cable	5/m
-403 Connector Pair for -402 Cable	95
-431 Extender Chassis Power Supply	530

Software Options

2289A-901 Helios Toolbox for BASIC Programmers	350
2289A-902 CIMPAC Application Software Package	3695
S2289 ProLogger_HCL Application Software	295
S2290 LABTECH Notebook Application Software	995

Accessories (Also see page 485)

Y1702 RS-232C Null Modem Cable, 2m	125
Y1703 RS-232C Null Modem Cable, 4m	150
Y1705 RS-232C Null Modem Cable, 30cm	75
Y1707 RS-232C Standard Cable, 2m	125
Y1708 RS-232C Standard Cable, 10m	150
Y2044 24" Rack Slide and 8" Rack Mount Kit	195
Y2045 8" Rack Mount Kit	150
Y2047 Extender Chassis 3-Way Connector	75

Sales & Support

Warranty

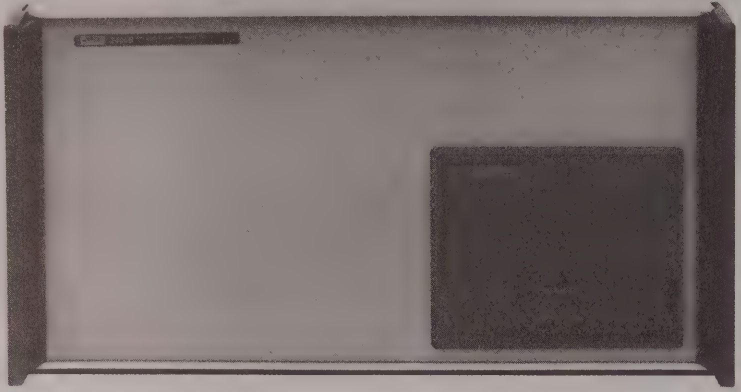
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

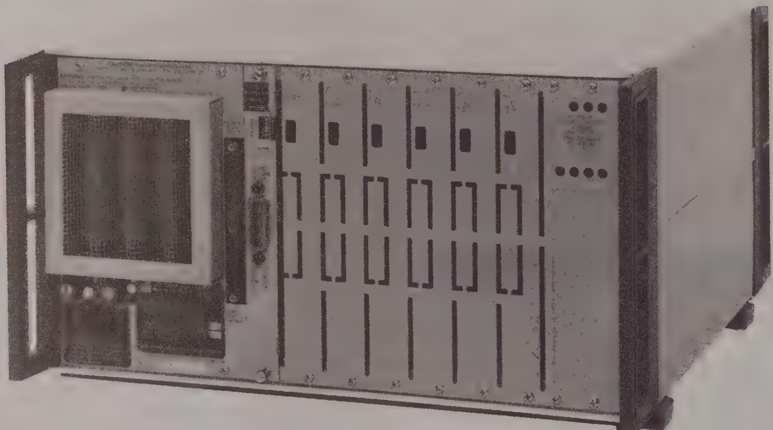
SC1-2289A Repair (w/calibration)	392
SC1-2289A Repair (cal w/in or out data)	427
SC1-2289A Repair (cal w/in and out data)	462
SC2-2289A Cal (1 per yr recommended)	94
SC2-2289A Cal (1 per yr w/ in or out data)	129
SC2-2289A Cal (1 per yr w/in & out data)	164
SC1-22810A Repair (w/calibration)	392
SC1-22810A Repair (cal w/in or out data)	427
SC1-22810A Repair (cal w/in and out data)	462
SC2-22810A Cal (1 per yr recommended)	94
SC2-22810A Cal (1 per yr w/in or out data)	129
SC2-22810A Cal (1 per yr w/in & out data)	164
SC1-2281A Repair (w/calibration)	226
SC1-2281A Repair (cal w/in or out data)	261
SC1-2281A Repair (cal w/in and out data)	296
SC2-2281A Cal (1 per yr recommended)	94
SC2-2281A Cal (1 per yr w/in or out data)	129
SC2-2281A Cal (1 per yr w/in & out data)	164

2400B

GPIB IEEE-488



2400B



2400B Rear Panel

The 2400B Intelligent Computer Front End is a very accurate microprocessor-based analog and digital data acquisition system. The system serves as an interface between a computer and both the measurement and control of a physical process.

The 2400B can receive a measurement and control program from the host computer and, upon command, execute it without further interaction with the computer. The 2400B relieves the host of routine, time consuming tasks and greatly simplifies the programmer's task of developing system software. Cost savings is the result, and greater throughput is possible because the computer can perform other tasks at "computer speed" without waiting for physical events.

The 2400B works well in applications requiring a distributed data acquisition and control system. With a Serial Interface Option (-001) 2400Bs may be located over 1220 meters (4000 feet) from the host computer in a star or daisy chain configuration.

Computers with which the 2400B will inter face are those with either RS-232-C, RS-422, GPIB/IEEE-488*, or 20 mA current loop compatibility. The Fluke 1752A Instrument Controller interfaces well with the 2400B and the combination (called a 2452MCS) is described in following pages.

Hardware costs are reduced by having a wide range of user-configurable, input and output plug-in circuit cards plus different types of extender chassis and interface options to perform the necessary measurement and control functions of your application. The 2400B has a maximum system capacity of over 1000 analog inputs, 1000 digital inputs, 128 analog outputs, and 1000 digital outputs.

Inputs

The 2400B accepts inputs from a wide variety of sources and transducers. For analog inputs, the 2400B uses its 17-bit analog-to-digital converter to perform accurate measurements of ac or dc voltage, current, or temperature using thermocouples. Integral signal conditioners are used in conjunction with the A-to-D converter to perform measurements of resistance, temperature (RTDs), strain, and certain other transducers.

Built-in linearizations are available for a wide variety of thermocouples. RTD linearizations are software-selectable by individually select ing parameters for different probes, assuring high accuracy.

Totalizing, as well as frequency, period, and rotation speed measurements, are performed with one of the Counter/Totalizer Options. To sense switch closures or logic levels, you may use the Status Input Option. Or, for faster response, use the Interrupt Input Option or the Sequence of Events Recorder Option. The Interrupt Option causes the 2400B to respond to external events immediately while the Sequence of Events Option records events with up to 0.1

2400B Intelligent Computer Front End

- A data acquisition "computer" in itself — measures, alarms, and controls independent of host
- Handles nearly any I/O requirement with an extensive selection of options
- High accuracy analog measurements — even in electrically noisy environments
- Modularly expandable (over 3000 total channels) to meet future application demands
- Interface to nearly any computer via RS-232, RS-422, GPIB/IEEE-488, or current loop
- Self documenting, structured program language — optimized for measurement and control
- EPROM program storage available for stand-alone dedicated applications

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

millisecond resolution. The Digital Input Option is used to read either 7-digit BCD or 24-bit binary words from devices with that output capability.

Outputs

The 2400B makes use of five different control output options. To light annunciators, or perform on-off control, use the Status Output Option or the Relay Output Option. Use the 2400B's other output cards for more complex process control. A Resistance Output Option may be programmed to supply resistances from 0 to 100,000 ohms. For -10V to +10V dc or 4 to 20 mA control loops, or driving analog recorders, use the Analog Output Option. To control stepper motors, use the Stepper Motor Output Option. Frequency and acceleration rates may be selected through the 2400B's software for stepper motor control.

Expandability

A 2400B system may be large or small, depending upon the application. The 2400B main frame has six slots for any combination of input, output, or interface plug-in modules. To expand the system, just add extender chassis. However, only one A-to-D converter is needed for a 2400B system to measure analog signals, even if the maximum number of channels is installed.

Several 2400Bs may be interfaced to a single computer. When equipped with either the RS-422, or 20 mA current loop interface, 2400Bs may be arranged in a multi-drop configuration at distances up to 1220 meters (4000 feet) from the host computer. Greater distances are possible utilizing the 2400B's RS-232-C interface and modems, over existing telephone lines.

Flexible Software

The 2400B can be utilized with two "levels" of software. The first level is for immediate-mode commands, those which cause an immediate response from the 2400B. The second level is the program stored in the 2400B, allowing the 2400B to monitor and measure inputs, perform calculations, make decisions, and set control outputs, all independent of the host computer.

Stand-Alone Capability

By loading the 2400B's stored program into EPROMs in the mainframe, the 2400B can be used to monitor inputs, perform calculations, and update control outputs, without being connected to a host computer. Using one or both of the 2400B's RS-232 ports in conjunction with the Fluke Touch Control Screen Series allows stored program data to be presented and modified by an operator, all under the program's control. Approximately 400 lines of 2400B program may be stored in EPROM.

Worldwide Support

Service centers for Fluke products are located in more than forty countries around the world. Many offer full service contracts for maintenance and repair at your site. Or training for your personnel can be arranged. We know how important it is to be assured of expert maintenance for systems you depend on, even though they may be among the most troublefree available — like those from Fluke.

Specifications

2400B System

Analog Inputs: ≤1000 isolated, 3-, 4-, or 6-wire channels
Digital Inputs: ≤1024 non-isolated lines, configurable for either (1) 7 BCD digits plus 1 sign bit plus 3 bits for decimal point location or (2) 24-bit binary plus 1 sign bit
Status Inputs: ≤1024 electrically isolated wirepairs
Interrupt Inputs: 132 electrically isolated wirepairs
Counter-Totalizer Inputs: 132 isolated analog and 132 non-isolated TTL inputs
Status Outputs: ≤1024 electrically isolated wirepairs
Analog Outputs: ≤128 voltage and/or current sources in range of -10V to +10V or 0 to 20 mA
Resistance Outputs: 164 resistance sources with 1Ω increments to 4095Ω and/or 25Ω increments to 102,375Ω
Stepper Motor Outputs: ≤32 direct or logic level outputs

2400B Mainframe

The 2400B must have either option -001 or Option -002 installed to be operational.
Capacity: Six slots for any combination of input, output, or extender chassis interface plug-in modules. A-to-D converter module (Option -109) installed in a dedicated additional slot
Serial Outputs: EIA Standard RS-232-C, two ports, output only

Options

Serial Interface Option (-001)

Bi-directional serial interface to compatible host computer. This option is configurable as either an RS-232-C, RS-422, or 20 mA current loop via a changeable jumper. As an RS-232-C interface, Option -001 supports five protocols.

IEEE-488 Interface Option (-002)

Bi-directional IEEE-488 interface to compatible host computer or instrument controller such as Fluke 1722A.

2401A Scanner Extender Chassis

Capacity: Ten scanner modules (Option -101, -115, or -117) 100 analog input channels
System Size: Ten maximum
Maximum Distance: 15 meters (50 feet) from 2400B or 2403A. A 2-meter cable included

2402A I/O Extender Chassis

Capacity: 12 input and/or output plug-in modules. Option 2402A-501 required. Installed in 2400B
System Size: 16 maximum
Maximum Distance: 15 meters (50 feet) from 2400B. A 2-meter cable included

2403A Remote A/D Extender Chassis

Capacity: Eight slots for signal conditioners, scanner modules (Option -101, -115 or -117) plus two slots for Interface Options (-401) for up to ten 2401s. One A/D module required (Option -109). Option 2403A-601 also required
Maximum Distance: 1220 meters (4000 feet) from 2400B. Order cable by length (Opt -602) plus installed connectors (Opt -603)

High Performance A/D Converter Option (-109)

Required for all analog measurement inputs. Only one allowed for each 2400B System.
Input Resistance: <200 MΩ in 0.1V, 0.8V, and 6.4V range; 10 MΩ in 100V range
Input Capacitance: 0.005 µF at 25 readings per second; 0.5 µF at 3 readings per second
Zero Stability: Automatically zeroed before each measurement

Voltage, Current, Thermocouple Inputs

High Performance Scanner Option (-101)

Ten 3-wire dry reed relays (Hi, Lo, shield).
Thermal Offset: <1 µV per channel
Maximum Voltage: 350V dc or peak ac between any input terminal and system ground or other terminal
Temperature Resolution: 0.1 degree (one count)

Thermocouple and DC Voltage Input Connector Option (-102)

Ten 3-wire sets of screw terminals on isothermal block enclosed in a safety housing. Integral reference junction correction for 0°C. Plugs into Scanner Module (Option -101).

DC Voltage Input Connector Option (-108)

Ten 3-wire sets of screw terminals for input wires enclosed in safety housing. Plugs into scanner module (Option -101)
Range: -100V to +100V
Maximum Voltage: 350V dc or peak ac. See Option -101

Temperature Measurement Accuracy

Measurement may be performed in Celsius, Fahrenheit, Kelvin, or Rankine (w/option -101, -102)

Thermocouple Type	Range °C	24 hours 21°C to 25C°		90 Days 18°C to28°C		1 Year 13°C to 33°C	
		Low Reading Rate	High Reading Rate	Low Reading Rate	High Reading Rate	Low Reading Rate	High Reading Rate
JNBS	-200 to -160	0.40	0.55	0.50	0.60	0.70	0.75
	-160 to 0	0.30	0.40	0.35	0.45	0.50	0.55
	0 to 760	0.20	0.25	0.25	0.30	0.35	0.35
KNBS	-225 to -210	0.70	1.00	0.85	1.10	1.30	1.40
	-210 to -160	0.55	0.80	0.65	0.90	1.00	1.10
	-160 to -80	0.35	0.50	0.40	0.55	0.60	0.70
	-80 to +1350	0.25	0.35	0.30	0.40	0.45	0.50
TNBS	-230 to -210	0.70	0.95	0.80	1.05	1.20	1.35
	-210 to -150	0.50	0.75	0.60	0.80	0.95	1.05
	-150 to -50	0.35	0.50	0.40	0.55	0.60	0.70
	-50 to +400	0.25	0.35	0.30	0.40	0.45	0.50
ENBS	-250 to -230	1.00	1.25	1.15	1.40	1.65	1.80
	-230 to -180	0.60	0.75	0.70	0.85	0.95	1.05
	-180 to 0	0.35	0.45	0.40	0.50	0.55	0.60
	0 to +1000	0.20	0.25	0.25	0.30	0.30	0.35
RNBS	0 to 60	0.80	1.55	1.00	1.75	1.95	2.35
	60 to 200	0.65	1.25	0.80	1.40	1.55	1.85
	200 to 600	0.50	0.95	0.65	1.10	1.20	1.40
	600 to 1767	0.40	0.75	0.50	0.85	0.95	1.10
SNBS	0 to 60	0.80	1.55	1.00	1.75	1.90	2.30
	60 to 200	0.65	1.25	0.80	1.40	1.55	1.85
	200 to 600	0.55	1.00	0.65	1.10	1.25	1.50
	600 to 1767	0.45	0.85	0.55	0.95	1.05	1.25
BNBS	200 to 420	2.00	4.05	2.55	4.60	5.10	6.10
	420 to 750	1.00	1.95	1.25	2.15	2.40	2.85
	750 to 1150	0.60	1.15	0.75	1.30	1.45	1.70
	1150 to 1850	0.45	0.85	0.55	0.95	1.05	1.25
NNBS**	-200 to -170	0.60	0.95	0.70	1.05	1.20	1.35
	-170 to 0	0.45	0.70	0.55	0.80	0.85	1.00
	0 to 1300	0.25	0.40	0.30	0.45	0.50	0.55
CHOS***	0 to 1200	0.40	0.65	0.45	0.75	0.80	0.95
	1200 to 2315	0.55	0.95	0.70	1.10	1.25	1.45
JDIN	-200 to -100	0.35	0.40	0.40	0.45	0.50	0.55
	-100 to 200	0.25	0.30	0.30	0.35	0.40	0.45
	200 to 900	0.20	0.25	0.20	0.25	0.30	0.30

Includes all but sensor error: connector gradient, reference junction, linearization conformity, A-to-D conversion, temperature coefficient, time drift, scanner offset.

** *Nicrosil/Nisil*

*** *Hoskins Mfg. Co. Tungsten - 5% Rhenium vs Tungsten - 26% Rhenium*

DC Voltage Measurement Accuracy:

±(% Rdg + Counts + µV)*

Scan Rate	24 Hours 21°C to 25°C	90 Days 18°C to 28°C	1 Year 13°C to 33°C
0.1V, 0.8V, 6.4V Ranges			
3CH/S	±(0.002%+2+2)	±(0.005%+3+2)	±(0.015%+4+6)
25CH/S	±(0.002%+4+4)	±(0.005%+5+4)	±(0.015%+6+6)
100V Range			
3CH/S	±(0.008%+2+0)	±(0.01%+3+0)	±(0.02%+4+0)
25 CH/S	±(0.008%+4+0)	±(0.01%+5+0)	±(0.02%+6+0)

* *After 45 minute warm-up. With Option -109, -101, and -108 (or -102)*

AC Voltage Input Connector Option (-119)

Ten sets of 2-wire screw terminals for input wires enclosed in a safety housing. Plugs into scanner module (Option -101).

Voltage Range: 5V rms to 250V rms

Frequency Range: 45 Hz to 450 Hz

Conversion Method: 1/2-wave, average-responding, calibrated to indicate rms value of sinewave

Maximum Voltage: 250V rms or 250V dc

Accuracy: ±(1.0% of input +0.1V)

Current Input Connector Option (-106)

Specifications are the same as for Option -101 but with a precision 15Ω, 0.25 watt resistor in each channel to convert current to voltage. For 4 to 20 mA sources; 129 mA maximum. Plugs into Scanner Module (Option -101). Some other current values available on request.

RTDs, Ohms, 1/4-Bridge Strain Inputs Signal Conditioner Option (-701)

For Ohms, RTD, 1/4-bridge strain measurements.

Configuration: 3- or 4-wire, switch-selectable

Excitation Currents: 100 µA, 1 mA, 10 mA, switch-selectable

Accuracy: ±0.005% at calibration, 21°C to 25°C

Four-Wire Scanner Option (-115)

Capacity: Ten 4-wire channels (reed relays)

Noise Rejection: Same as Option -109 except common mode rejection is 120 dB and normal mode rejection is 60 dB

Maximum Voltage: 170V dc or peak ac between any channel and any other channel and/or ground. 30V dc or rms ac between any two lines on the same channel

Connector Option: Use 2400A-116

Note: This scanner may not be used for voltage measurements.

Four-Wire Input Connector Option (-116)

Ten 4-wire sets of screw terminals for input wires enclosed in safety housing. Plugs into Scanner Module Option (-115)

Maximum Voltage: Same as for Option -115.

Ohms Mode Specifications

Max Resistance	Resolution	Excitation Current
64,000Ω	1.0Ω	100 µA
8000Ω	0.1Ω	100 µA
800Ω	0.01Ω	1 mA
100Ω	0.001Ω	1 mA
10Ω	0.0001Ω	10 mA

Total System Accuracy: For 90 days, 18°C to 28°C, at 25 readings per second

Four-Wire: ±(0.021% of reading + 0.01% range)

Three-Wire: ±(0.021% of reading + 0.02% range + 0.21Ω)

RTD Mode Specifications

Resolution: 0.03°C

Total System Accuracy: For 90 days, 18°C to 28°C, at 25 readings per second, 4-wire:

100Ω Pt RTD with alpha = 0.00385: ±0.2°C at 0°C, ±0.3°C at 600°C

1/4-Bridge Strain Mode Specifications

Total System Accuracy*
350Ω Gage: ±(0.042% of reading + 14 microstrain)
Resolution: 0.2 microstrain
120Ω Gage: ±(0.042% of reading + 16 microstrain)
Resolution: 0.5 microstrain

1/2- and Full-Bridge Strain Measurements

Signal Conditioner Option (-702)

For 1/2- and full-bridge strain measurements
Excitation Voltage: 4,5,8,10,12,15, or 20V dc, software-selectable

Six-Wire Scanner Option (-117)

Capacity: Five 6-wire channels (reed relays)
Conductors: Excitation source (2); remote sense (2); analog input (2)
Noise Rejection: Same as Option -109 except common mode rejection is 120 dB and normal mode rejection is 60 dB
Maximum Voltage: 170V dc or peak ac between any channel and any other channel and/or ground. 30V dc or rms ac between any two lines on the same channel.
Connector Option: Use 2400A-118

Six-Wire Input Connector Option (-118)

Five 6-wire sets of screw terminals for input wires enclosed in safety housing. Plugs into six-wire scanner module Option -117

Total System Accuracy*

1/2-Bridge Mode: ±(0.015% of rdg + 4.5 microstrain) with both gages principally active
Full-Bridge Mode: ±(0.015% of rdg + 4.5 microstrain) with two gages principally active
Resolution: 0.5 microstrain

** For 90 days, 18°C to 28°C, 25 readings per second, 350Ω gage, 4V excitation*

Other Input Specifications

Counter/Totalizer Signal Input Option (-113)

May be used to perform the following measurements: Frequency, period, totalize, tachometer, "A" gated by "B", and time interval.
Inputs: TTL, Gate 1, Gate 2, Trigger, Count Up, Count Down, Up/Down, Count, Non-Isolated Common, Isolated Common, Isolated Analog Input
Analog Input Voltage Range: 50 mV to 30V rms
Frequency Range: 0 to 900 kHz (TTL Input); 10 Hz to 200 kHz (Analog Input)

Period Range
TTL Input: 1.1 µs to 6.7s
Analog Input: 5 µs to 0.1s
Period Resolution: 400 ns

Time Interval Range
TTL Input: 1 µs to 3.82 hr
Analog Input: 2 µs to 50 ms
Time Interval Resolution: 819 µs (≤3.82 hours); 400 ns (≤6.7 seconds)
Totalizer Input Range: Dc to 900 kHz
Minimum Pulse Width: 400 ns
Totalizer Capacity: -8,388,608 to +8,388,607
Connector: 12 screw terminals supplied with option

4 Channel Counter/Totalizer Option (-113/AA)

Measures period, frequency, time interval, and totalizes
Inputs: Four channels, non-isolated
Frequency Range: 0-500 kHz
Period Range: 10 µs to 50,000s
Totalizer Capacity: 4,999,999
Input Voltage Range: 175 mV to 70V rms
Connector: 12 screw terminals supplied with option

Digital Input Module Option (-103)

BCD Mode: 7 BCD digits +1 sign +3 decimal position bits
Binary Mode: 24 bits +1 sign bit
Logic Level: TTL, 0 to +0.75V low, +2.5 to +8V high
Rate: ≤250 words per second
Connector Options: Use 2400A-110 or -111

Status Input Module Option (-104)

Bits Per Module: 32, isolatable from system ground or other modules by up to 30V dc or peak ac
Format: Individually readable
Input: Contact closures or TTL level
Connector Option: Use 2400A-110 or -111

Sequence of Events Recorder Option (-104/AA)

Number of Inputs: 32 channels
Channels Per System: 1024 max
Resolution: 0.1 ms to 100 ms, selectable
Connector Option: Use 2400A-110 or -111

Interrupt Signal Input Option (-114)

Number of Inputs: 16
Input Logic: Contact closures or TTL level, switch-selectable
Connector Option: Use 2400A-110 or -111

Screw Terminal Connector Option (-110)

Terminals: 50, for wire sizes up to #14 AWG

Solder Pin Cable Connector Option (-111)

Terminals: 50, for wire sizes up to #22 AWG

Control Output Specifications

Analog Control Output Option (-302)

Outputs: Isolated. Four per module. Voltage (-10V to +10V) or current (0 to 20 mA), individually selectable
Isolation: ≤30V dc or peak ac, channel to channel
90-Day Accuracy: ±20 mV in voltage mode and ±20 µA in current mode for ambient temperature of 18°C to 28°C
Connector Option: Use 2400A-110 or -111

Status Output Control Option (-301)

Outputs: 32, open collector, diode clamped.
Isolation: ≤30V dc or peak ac, channel to channel or channel to ground
Connector Option: Use 2400A-110 or -111

Relay Output Card Option (-301/AA)

Number of Contacts: 16
Contact Rating: 250V ac at 3A with non-inductive load and 28V dc at 3A
Contact Arrangement: Form "C" (N.O. or N.C.)
Connector: Terminals supplied with option

Resistance Output Control Option (-305)

Outputs: Two
Isolation: 130V dc or peak ac channel to channel or channel to ground
Values: 0 to 4095Ω in 1Ωincrements
Connector: Four screw terminals supplied with option

Resistance Output Control Option (-306)

Outputs: Two
Isolation: ≤30V dc or peak ac, channel to channel or channel to ground
Values: 0 to 102,375Ω in 25Ω increments
Connector: Four screw terminals supplied with option

Stepper Motor Control Output Option (-307)

Number of Outputs: One, non-isolated
Input Signals: External Enable, Closed-Loop Feedback
Direct Output Signals: Four-Phase Unipolar Drive, Flyback Protected
Logic Output Signals: CW/CCW direction and Step Clock, or CW and CCW Clock Outputs; Busy/Done
Acceleration and Deceleration Rates: 114 Hz/ second to 97656 Hz/second. Software-selectable
Connector: 12 screw terminals, supplied with option

Note: Option -307 may be configured as a frequency source. Ask about Option -307/ABK

2400B

General Specifications

Shock and Vibration: Meets MIL-T-28800, Class 3 requirements
Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤80% to 40°C and ≤70% to 50°C, operating, non-condensing
Power: 90 to 132V ac or 180 to 264V ac, switch-selectable, 50 or 60 Hz ±2 Hz, 130 watts maximum
Size: 22 cm H x 43 cm W x 38 cm D (8.66 in x 16.9 in x 14.96 in) for 2400B, 2401A, 2402A, and 2403A. Fit standard 19-inch rack
Weight*
2400B: 11.4 kg (25 lb)
2401A: 6.4 kg (14 lb)
2402A: 11 kg (24 lb)
2403A: 8.2 kg (18 lb)
**Approximate, fully loaded*
Included: Manual Set, Getting Started Guide and power cord

Ordering Information

Models

January 1989 prices

2400B* Intelligent Computer Front End	$4900
2401A Scanner Extender Chassis	1500
2402A I/O Extender Chassis	2400
2403A Remote A/D Extender	1850

**Option -001 or -002 is required*

Options (for above models)

-001 Serial Interface	840
-002 IEEE-488 Interface	840
-101 High Performance Scanner	500
-102 Thermocouple Input Connector	200
-103 Digital Signal Input	475
-104 Status Signal Input	$570
-104/AA Sequence of Events Recorder	on req.
-106 Current Input Connector	240
-108 DC Voltage Input Connector	150
-109 High Performance A/D Converter**	1285
-110 Screw Terminal I/O Connector	150
-111 Solder Pin I/O Connector	50
-113 Counter/Totalizer Signal Input	675
-113/AA 4 Channel Counter/Totalizer	on req.
-114 Interrupt-Signal Input	590
-115 Four-Wire Scanner	520
-116 Four-Wire Input Connector	150
-117 Six-Wire Scanner	575
-118 Six-Wire Input Connector	150
-119 AC Voltage Input Connector	230
-301 Status Output	550
-301/AA Relay Output	on req.
-302 Current/Voltage Analog Output	995
-305 Resistance Output (1Ω-4 kΩ)	710
-306 Resistance Output (25Ω-100 kΩ)	710
-307 Stepper Motor Control Output	750
-401 Scanner Extender Interface	170
-402 Extender Cable (custom length)	25/m
-403 Connectors for 2401A-402 Cable	220
-501 I/O Extender Interface	340
-502 I/O Cable (with connectors, 9m)	315
-601 Remote A/D Extender Interface	290
-602 A/D Extender Cable (custom length)	5/m
-603 Connectors for 2403A-602 Cable	75
-701 Signal Conditioner for Ohms, RTD's 1/4- & 1/2-Bridge Strain Measurements	575
-702 Signal Conditioner for 1/2- and Full-Bridge Strain Measurements	685

***Required for analog measurements*

Accessories (Also see page 485)

Y1707 2m Cable for RS-232-C	$125
Y1705 RS-232-C Null Modem Cable	75
Y8022 IEEE-488 Shielded Interface Cable, 2m	145
Y2053 Rack Adapter w/24" slides	195
Y2054 19" Rack Adapter w/o slides	150
Y2055 RS-422 Multi-connector	95

Service & Support

Warranty

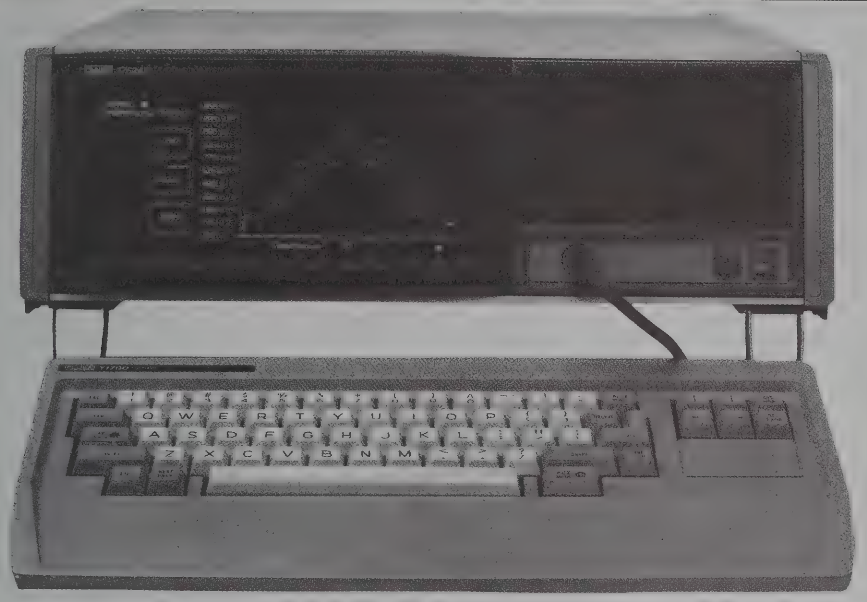
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2400B Repair (w/ calibration)	689
SC1-2400B Repair (cal w/in or out data)	724
SC1-2400B Repair (cal w/in and out data)	759
SC2-2400B Cal (1 per yr recommended)	126
SC2-2400B Cal (1 per yr w/in or out data)	161
SC2-2400B Cal (1 per yr w/in & out data)	196
SC1-2401A Repair (w/ calibration)	204
SC1-2401A Repair (cal w/in or out data)	239
SC1-2401A Repair (cal w/in and out data)	274
SC2-2401A Cal (1 per yr recommended)	94
SC2-2401A Cal (1 per yr w/in or out data)	129
SC2-2401A Cal (1 per yr w/in & out data)	164
SC1-2402A Repair (w/ calibration)	230
SC1-2402A Repair (cal w/in or out data)	265
SC1-2402A Repair (cal w/in and out data)	300
SC2-2402A Cal (1 per yr recommended)	94
SC2-2402A Cal (1 per yr w/in or out data)	129
SC2-2402A Cal (1 per yr w/in & out data)	164
SC1-2403A Repair (w/ calibration)	287
SC1-2403A Repair (cal w/in or out data)	322
SC1-2403A Repair (cal w/in and out data)	357
SC2-2403A Cal (1 per yr recommended)	94
SC2-2403A Cal (1 per yr w/in or out data)	129
SC2-2403A Cal (1 per yr w/in & out data)	164

1752A

GPIB
IEEE-488



1752A

1752A Data Acquisition System

- Analog measurements to 1,000 per second, accuracy of 0.02%
- Touch Sense Graphics Display
- High performance processor with Macrostore™ floating point processing
- 136K bytes of RAM. Expandable to 3.0M bytes
- 400K-byte floppy disk
- BASIC. Programmable with real-time and measurement and control extensions
- GPIB/IEEE-488, RS-232/422, Current Loop and Parallel Interfaces
- Rack mountable with removable keyboard
- Analog Control Option (voltage or current)
- Status Input/Output Option
- Counter/Totalizer Option
- Signal conditioning for dc/ac volts, thermocouples, RTD, strain

The Fluke 1752A Data Acquisition System is a powerful microcomputer-based system for measurement and control applications. The data acquisition functions are integrated into the same chassis as the computer to minimize desktop or rack space, simplify programming, and increase system performance. The 1752A's BASIC offerings provide a structured programming environment tailored for high speed data acquisition and instrument control. Single-word commands simplify the task of writing programs for both data acquisition and GPIB/IEEE-488* compatible instrument control.

Its touch screen replaces a keyboard or switch panel, allowing the operator to respond to prompts one at a time. System control may then be accomplished by simply touching the screen.

High Performance Microcomputer

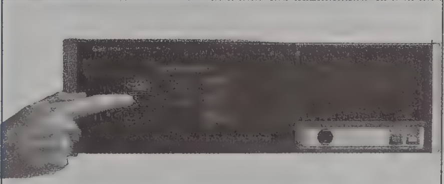
The 1752A is a microcomputer designed for control of automated instrument systems in the laboratory, the plant, or the factory and for information management systems.

The 1752A's high speed 16-bit microprocessor uses a 24 MHz clock to achieve an instruction cycle rate of 6 MHz. High-speed floating point arithmetic processing is implemented through extensions to the microprocessor instruction set. A separate display processor, with high speed vector generator and graphics memory workspace, functions as an independent graphics display terminal for the central processor.

The 1752A is easily configured to automatically start running your application software. On power-up the 1752A loads operating software from its internal floppy disk then executes a command file which instructs it to perform any desired task sequence. Alternatively, the 1752A may be operated as a diskless system when equipped with optional non-volatile RAM. Additionally, since the operating software is soft-loaded, updating is as easy as inserting a new disk and restarting.

RAM memory in the 1752A can be partially allocated as a file-structured electronic disk for high speed task overlays and large fast-access virtual data arrays. Software development tools make the task of writing programs more efficient through such features as wildcard file identification, utility command files, and recall of previously typed commands.

The 1752A includes four slots for additional memory and interface options. The standard 136K RAM memory is internally expandable to over 3 megabytes. The 400K-byte internal floppy disk drive capacity can be expanded through the 1760A or 1761A Disk Drives to 2 megabytes of on-line floppy disk file storage. An external Winchester Disk Drive System brings 20 megabytes of file capacity on-line. Non-volatile RAM options can be installed for rugged, permanent file storage, especially suited for harsh environments. Up to 2.5M bytes of non-volatile memory may be installed.



Touch-Sensitive Display System

Touch-Sensitive Display System

With its touch-sensitive display, the 1752A is particularly well suited for applications where semi-skilled personnel need to operate complex systems performing sophisticated tasks. The friendly graphics display takes the place of the often-intimidating keyboard, yet offers access to the software that keeps your system running. An operator is prompted one step at a time for information or decisions through informational displays, and responds by simply touching the screen. Systems based on this concept are

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

easily updated for new tasks: the cost and downtime of installing new switch or key labels is eliminated.

Fluke's experience producing the touch-sensitive display overlay goes back to 1979. It has proven to be a rugged, reliable component.

Characters Plus Graphics

The graphics display capability of the 1752A is independent of its character display, and of the 1752A central processor. With its own display processor, high speed vector generation hardware, and 64K graphics display memory, the 1752A is a sophisticated tool in the hands of the creative system designer. The 64K display workspace is over three times the size of the 640 by 224 pixel display window: 2048 pixels wide by 256 pixels high. You can use it to display data in strip chart form, and move the display across the window by touch commands. You can also use it to prepare up to three independent data screens available for instant display. Once the graphics display is generated, a hard copy of the graphics plane can be printed under program control.

The 1752A character display is an independent function that can overlay graphics data displays for labels, or be used alone for text and for programming. Because the graphics and character displays can be independently enabled, screens can be prepared "off-line" and displayed when ready. Numerous ANSI-compatible character attributes are available to add emphasis to portions of displays. Attributes such as inverse or underline can be pre-defined for display fields, or made a part of characters as they are sent to the screen.

The 1752A includes an industry standard composite video output that will display whatever is on the 1752A screen on a video monitor. This can be useful for training presentations as well as for system requirements that include a remotely mounted display.

Data Acquisition and Control

The 1752A-010 Analog Measurement Processor allows the 1752A to connect to 16 differential or 32 single-ended inputs, and acquire data at up to 1,000 readings per second. Multiple 1752A-010's may be installed to increase system throughput to 4,000 readings per second. (Any single input, however, can be sampled at a maximum rate of 1,000 per second.) Normal mode rejection may be added through either internal line synchronization, or external synchronization, using the Y1752A Line Synchronization Transformer. The Analog Measurement Processor interfaces to the 1752A bus without isolation. Inputs are protected against damage to 50V dc, and fused input resistors decrease the risk of dangerous higher voltages reaching system operators. An external signal conditioning subsystem is available which provides isolation as well as signal conditioning for inputs such as ac voltages, thermocouples, RTDs and strain.

For analog control, use the 1752A-011. This option allows the 1752A to control devices which accept a 0 to 20 mA or a ±10V dc control signal. Each of the four outputs can be individually configured for either current or voltage.

For frequency, time, and totalizing measurements, the 1752A-012 option offers a single input. To sense switch closures or logic levels, as well as perform on-off control, use the 17XXA-002 Parallel Interface. This option offers 32 bits configurable for either input or output. To switch higher levels, an optional digital isolation subsystem is available. To expand your system, use the 1702A Extender Chassis. This increases the number of slots available for measurement and control options by 11. More 1702As may be added for larger systems.

Interfacing

The 1752A includes an IEEE-488 bus interface and an RS-232-C serial data port. The IEEE-488 interface can control up to 14 instruments at transfer rates of up to 30K bytes per second. Powerful IEEE-488 commands are supported as a part of each 1752A programming language. The 1752A can be set up to function as a system controller or as an addressable device in a multiple-controller system. In either configuration, the 1752A can pass control to another controller and take it back when offered. As system controller, the 1752A starts up as controller-in-charge and can use IFC (Interface Clear) to reset all bus devices.

Three of the five expansion slots are available for additional interfaces:

Option 17XXA-008 adds an IEEE-488 interface and an additional RS-232-C serial data port. The 1752A can accomodate up to four IEEE-488 ports.

Option 17XXA-009 is a reconfigurable, dual serial-data port with its own buffer memory. It is supplied configured for RS-232-C with full modem compatibility. Each port can be easily reconfigured for a 20 milliamp current loop, or for RS-422 balanced lines. Up to three -009s may be installed for a total system of seven serial ports.

Option 17XXA-002 (Parallel Interface) gives you two independent 16-bit parallel I/O ports that can function as independent lines, 8-bit bytes, or 16 or 32-bit words. Line protocol is available (but not required), and the sense of the data can be reconfigured to either High true or Low true. A maximum of three modules may be installed for a total of six 16-bit ports.

Options & Peripherals

RAM Memory Expansion Modules (-006, -007, -016, -017)

Internal program and data space may be expanded to over 3M bytes with RAM expansion options. Memory may be added in the following increments:

17XXA-006 256K bytes
17XXA-007 512K bytes
17XXA-016 1M bytes
17XXA-017 2M bytes

Application programs can assign any part of this memory to function as an "Electronic Disk." Programs and data may be loaded to this E-Disk, allowing faster transfer rates and no disk wear.

Non-volatile RAM Options (-018, -019, -020)

These options provide either 256K bytes (-018), 512K bytes (-019) or 1M bytes (-020) of file-structured, non-volatile RAM memory. Transfer rates are comparable to RAM – over 1M bytes per second. Up to 4M bytes non-volatile RAM may be installed in the 1752A.

Non-volatile RAM is a solid-state medium which is immune to pollution and vibration, making it ideal for harsh environments where floppy disk operation is not practical. Non-volatile RAM is battery backed up for up to five years to retain its file contents through a power loss. Since non-volatile RAM has a much greater tolerance to temperature extremes than other media, the 1722A can operate from 0°C to 40°C when non-volatile RAM is the primary file storage medium. Non-volatile RAM provides a write protection switch to protect its file contents.

Internal Winchester Disk Drive

John Fluke Mfg. Co., Inc. will be introducing an internal Winchester disk drive for the 1752A in April 1989. For further information please contact your local Fluke Sales Engineer or Representative.

External Floppy Disk Drive Systems (1760A and 1761A)

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage. The 1760A and 1761A use double-density dual-head disk drives. The full on-line capacity is 400K bytes for the 1760A, and 800K bytes for the 1761A, including a file directory for each floppy disk. They interface to the 1752A via the IEEE-488 port. Both systems are rack mountable and easy to install and use. Transfer rate is 22K bytes per second. Up to two 1761As can be accommodated, for a total of 2M bytes of on-line floppy disk file space.

External Winchester Disk Drives

The 1765B Series of Winchester disk drives provides high-capacity hard disk file storage for the 1752A Data Acquisition System:

1765B/20 20M byte Winchester Disk Drive
1765B/20M Multi-User 20M Byte Winchester Disk Drive

Both models provide easy connection to the Data Acquisition System through a stand ard IEEE-488 interface, and are rack-mountable, using the optional rack-mount kit. More information is available in the following "disk drive" section.

Floating Point Math Coprocessor

John Fluke Mfg. Co., Inc. will be introducing a floating point math coprocessor for the 1752A in April 1989. For further information please contact your local Fluke Sales Engineer or Representative.

High Speed Data Acquisition and Control

A 1752A option that provides high speed sampling of analog inputs up to 60 kHz is available through Fluke Customer Support Services. This option, called the Multifunction Board, also has the capability of accepting digital inputs and sourcing digital and analog outputs for control of quickly changing parameters.

See a more thorough description of the Multifunction Board in the Customer Support Services section (page 467) and consult your Fluke Account Manager for full details.

Software

The 1752A offers an environment specifically suited to the development of real-time control programs. Interpreted BASIC, Compiler BASIC, FORTRAN, Assembly, C and several utility softwares are available. For more information on 1752A software systems, consult the 1700 Series Software section, following this section. A data acquisition library provides routines directly accessible from BASIC, greatly simplifying data acquisition and control tasks. The "Getting Started" software provides the user with a number of useful programs, allowing the user to access many of the 1752A's capabilities through the touch screen.

Module-Level Diagnostics

The 1752A is a modular design with diagnostic software that allows semi-skilled operators to identify failures to the module level. Spare-module kits are available for the most time-critical applications. Fluke also maintains an inventory of 1752A modules that may be shipped within hours in most cases, and which can be exchanged for a defective module for a nominal charge. Contact your Fluke Technical Service Center for more information.

Manuals That Make the Task Easy

Experience will tell you that the major investment in an automated instrument system is not usually in the hardware, but in system integration and the development of application software to run it. The quality of documentation is a key consideration. You will find that 1752A manuals are among the most readable, consistent, and sensible software documentation available anywhere. Ask your Fluke Sales Engineer or Representative to let you evaluate the 1752A through its manuals. You will be pleasantly surprised.

Specifications

Option Specifications

Analog Measurement Processor (-010)

Number of Channels: 16 differential or 32 single-ended (single and differential channels may be mixed)
System Capacity: 4 processors, 128 single-ended channels
Ranges: (full scale, each channel) ±1.0158V; ±10.158V; ±65 mA; 4 to 20 mA displayed as 0 to 100% of scale
Resolution: (16 bits) 10V range, 310 µV; 1V range, 31 µV; 65 mA range, 2.07 µA, (15 ohm, 0.04%, 20 ppm TC sense resistor)
Reading Rate: Synchronized Modes-400 channels/s @50 Hz, 480 channels/s @60 Hz, 400 channels/s @400 Hz; Asynchronous Mode 1000 channels/s
Accuracy (90 days): (10 to 40°C operating) 10V range ±(0.02% of reading + 1.24 mV); 1V range ±(0.02% of reading + 248 µV); 65 mA range ±(0.05% of reading + 16.5 µA)
Common Mode Rejection: dc -77 dB; 50/60 Hz, 60 dB
Normal Mode Rejection: Asynchronous mode, 0 dB; internally synchronized, 20 dB; Externally synchronized, 45 dB
Input Protection: To 50V rms without side effects, fuse protected to 240V rms
Connector: Requires two Y1750s

Analog Control Output (-011)

Outputs: Isolated. Four per module. Voltage (-10V to +10V) or current (0 to 20 mA), individually selectable
Resolution: 2 mV (13 bits) or 5 µA (12 bits)
Isolation: ≤30V dc or peak ac, channel to channel
Max Load: ±5 mA in voltage mode; ≤750Ω in current mode
90-Day Accuracy: ±20 mV in voltage mode and ±20 µA in current mode for ambient tempera ture of 18°C to 28°C
Rate: 1000 changes/sec
Connector Option: Use 2400A-110 or -111

Counter/Totalizer Signal Input (-012)

May be used to perform the following measurements: Frequency, period, totalize, tachometer, "A" gated by "B", and time interval.

Inputs: TTL, Gate 1, Gate 2, Trigger, Count Up, Count Down, Up/Down, Count, Non-Isolated Common, Isolated Common, Isolated Analog Input
Isolation: Both Analog Input and Isolated Common are isolated from the 1752A and/or ground up to 30V and up to 1.0 V/µs maximum slew rate
Frequency Range: 0 to 900 kHz (TTL Input); 10 Hz to 200 kHz (Analog Input)
Period Range
TTL Input: 1.1 µs to 6.7s
Analog Input: 5 µs to 0.1s
Period Resolution: 400 ns
Time Interval Range
TTL Input: 1 µs to 3.82 hr
Analog Input: 2 µs to 50 ms
Time Interval Resolution: 819 µs (≤3.82 hours); 400 ns (≤6.7 seconds)
Totalizer Input Range: Dc to 900 kHz
Minimum Pulse Width: 400 ns
Totalizer Capacity: -8,388,608 to +8,388,607
Connector: 12 conductors, supplied with option (screw terminals)

Parallel Interface (-002)

Data I/O lines terminated with 24008 to +5V, 5000Ω to ground, with diode input protection. Schematics provided with documentation. Up date rate: 3000/s (status output).

General Specifications

Temperature: 10°C to 40°C with floppy disk, operating; 0°C to 40°C without floppy disk, operating. 10°C to 52°C with floppy disk, non-operating; -20°C to 60°C without floppy disk, non-operating
Relative Humidity: 20% to 80%, non-condensing, operating; 8% to 90% non-condensing, with floppy disk, non-operating or 5% to 95%, non-condensing, without floppy disk, non-operating
EMI and RFI Emissions: Tested to FCC Part 15, Subpart J, Class B; VDE 0871, Class B; CISPR 11-1975
Power: 90V to 132V ac or 180V to 264V ac, 47 Hz to 440 Hz. 175W maximum
Size: 13 cm H x 43 cm W x 55 cm L (5.25 in x 17 in x 21.5 in) plus feet
Weight: 14.5 kg (34 lb). Keyboard 1.4 kg (3 lb)
Included: Y1700 Keyboard, power cord, BASIC system disk, diagnostic disk, "Getting Started" manual and disk, System Guide manual, Operator's manual, BASIC Programming Manual, Data Acquisition and Control Guide, and a pad of 50 display worksheets

1752A

Ordering Information

Models

January 1989 prices

1752A Data Acquisition System (w/one 1752A-010 Analog Measurement Processor)	$7980
1752A-1 Data Acquisition System (w/o 1752A-010 Analog Meas. Processor)	7080
1702A Extender Chassis (Requires 1752A-013)	2260

Options (for above Models)

-002 Parallel Interface	990
-006 256K byte RAM Memory Expansion	1000
-007 512K byte RAM Memory Expansion	1400
-008 IEEE-488/RS-232-C Interface	850
-009 Dual Serial Interface	990
-010 Analog Measurement Processor	990
-011 4 Channel Analog Output	990
-012 Counter/Totalizer	675
-013 Extender Interface	510
-016 1M Byte RAM Memory Expansion	1800
-017 2M Byte RAM Memory Expansion	3200
-018 256K Byte Non-Volatile RAM	1700
-019 512K Byte Non-Volatile RAM	2700
-020 1M Byte Non-Volatile RAM	3700

Language Systems (See page 368)

-200U 1752A System Software Update	150
-201 Assembly Language Development System	1495
-202 FORTRAN Development System	1495
-203 Compiled BASIC Development System	490
-205 Extended BASIC Development System	$ 490
-912 Non-ANSI C Development System	1995
-913 Non-ANSI C Compiler	1495

Software Options (See page 371)

-900 Binder	30
-901 Gabby	195
-902 Touchscreen Toolbox	295
-903 Compiled MenuBASIC	295
-905 Extended MenuBASIC	295
-907 Transport–>PC	450
S1703 Compiled MenuBASIC Development Package	1900
S1705 Extended MenuBASIC Development Package	1900

Peripherals

1020 Touch Control Screen (includes a desk-top enclosure)	1820
1021 Touch Control Screen	1695
1760A Disk Drive System, 400K byte	1950
1761 Dual Disk Drive System, 800K byte	2950
1765B/20 20M byte Winchester Disk Drive	3295
1765B/20M Multi-User 20M byte Winchester Disk Drive	on req
1780A InfoTouch Display	2150

Accessories (Also see page 485)

Y1700 Programmer Keyboard	395
Y1702 RS-232-C Null Modem Cable, 2m	125
Y1703 RS-232-C Null Modem Cable, 4m	150
Y1705 RS-232-C Null Modem Cable, 0.3m	75
Y1706 Certified Blank Disks Unformatted (pkg of 10)	$ 60
Y1707 RS-232-C Interface Cable, 2m	125
Y1708 RS-232-C Interface Cable, 10m	150
Y1709 Printer Cable, 2m	125
Y1717 Parallel Interface Cable	150
Y1750 Input Terminal Block w/Cable	60
Y1751 Replacement Cable Set for Y1750	65
Y1752 Line Frequency Sync Transformer	50
Y1790 Rack Mount Kit w/24" Slides	195
Y1791 Rack Mount Kit for 1780A (requires slides)	95
Y1795 Portable Carry Handle	48
M00-260-610 18" Rack Slides	130
M00-280-610 24" Rack Slides	130
Y8021 Shielded IEEE-488 Interface Cable, 1m	130
Y8022 Shielded IEEE-488 Interface Cable, 2m	145
Y8023 Shielded IEEE-488 Interface Cable, 4m	155

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1752A Repair (w/calibration)	282
SC1-1752A Repair (cal w/in or out data)	317
SC1-1752A Repair (cal w/in and out data)	352
SC2-1752A Cal (1 per yr recommended)	63
SC2-1752A Cal (1 per yr w/in or out data)	98
SC2-1752A Cal (1 per yr w/in & out data)	133

2452MCS

GPIB
IEEE-488

2452MCS

2452MCS Measurement & Control System

- Complete system – combines 2400B Intelligent Computer Front End, 1752A Data Acquisition System, and software
- Extensive selection of I/O options – expandable to over 1000 channels with 2401A and 2402A extender chassis
- Touch Screen – friendly operator interface with graphics
- "Multi-computing" – 2400B handles scanning, linearizations, limit checking and direct control of test or process. 1752A downloads and modifies 2400B program, retrieves scanned data, formats and outputs reports, and provides operator interface
- Available with or without 28 inch high cabinet
- Choice of GPIB/IEEE-488 or Serial (RS-232-C, RS-422) Interfaces

The 2452MCS is a fully integrated measurement and control system which combines the power of two intelligent Fluke instruments – the 1752A Data Acquisition System and the 2400B Intelligent Computer Front End. The system is housed in a locking cabinet that fits on either a work bench or separate stand and includes all the hardware, cables, drawers, etc., necessary to combine the 2400B and 1752A into a complete measurement and control system. Alternatively, the 2452MCS may be ordered without a cabinet to be mounted in your own rack or panel.

The 2400B provides digital and analog measurement, signal conditioning, control outputs, and intelligent decision making, while the 1752A provides tremendous computing power, high speed data acquisition, a CRT display with a touch-sensitive overlay, advanced graphics capabilities, and mass storage via a double-sided floppy disk. Both instruments work together, sometimes independently, sometimes cooperatively, providing a multi-computing system with the power and flexibility to expand as your application requirements increase.

The programmer's keyboard is placed on a convenient sliding rack drawer that may be locked to prevent unauthorized program modification. The system can be programmed to allow the touch-sensitive CRT display to be the operator's interface. This reduces operator errors and training time because the operator interacts with a friendly CRT display customized for the application and written in familiar words.

The 2452MCS, when equipped with the 2400B's Serial interface, permits the 2400B to be located up to 1220 meters (4000 feet) away from the 1752A. A distributed data acquisition system may be constructed in this manner using a single 1722A or 1752A and multiple 2400Bs, in either star or "daisy chain" configurations.

The basic 2452MCS System includes the software tools, and hardware necessary to make it operate as a ten-channel data acquisition system. The system is expandable to sixty channels in the basic 2400B mainframe and to over 1000 channels by adding 2401A and/or 2402A Extender Chassis and intput/output options.

Input/Output Capabilities

The measurement of analog inputs such as thermocouples, RTDs, strain gages, dc and ac voltages, and currents can be performed by a 17-bit A/D converter in the 2400B. Capable of resolving 1 μV, the highly accurate A/D conversion preserves data integrity through a sophisticated noise rejection technique that synchronizes its measurement period with the power line frequency. For high speed measurements, analog inputs can be brought directly in to an optional analog measurement processor in the 1752A for 14 bit resolution at 1000 readings per second.

Digital inputs accommodated by the 2452MCS incude status, contact closure, interrupt, BCD, pulse, frequency, totalizing and sequence of events.

Controlling outputs sourced by the 2452MCS consist of voltage, 4-20 mA current, resistance, stepper motor control, TTL outputs, and relay closures. A complete description of input/output capabilities is found in the pages describing the 2400B.

Software Options Included

Software supplied with the system includes a program development package ("ProLink II", an enhanced BASIC interpreter with extended graphics capabilities, an advanced Editor, and a File Utility Program. The 2452MCS -03 and -04 also include the ProComm software package. (ProLink II and ProComm are both described in a section immediately following the 2452MCS description.) This complete package provides the tools necessary for a programmer to create a custom tailored data acquisition program.

If you want to "come up to speed" and write your application program in a hurry, consider the ProGen Application Software (S2452) package described on the following page. Alternatively, Fluke can help with training classes held either at our offices or at your site. We can also arrange for one of our in-house experts to assist you personally in creating your application-solving software.

Turnkey Systems

Fluke Customer Support Services System Integration group and Fluke Cooperative Services (FCS) are available to write custom application software and combine with Fluke hardware for a complete system. In fact if a turnkey system is what you require, Fluke has a list of Fluke Cooperative Service partners that are experienced with Fluke equipment and capable of fulfilling your needs in several unique industry segments.

Information on training classes, Customer Support Service and FCS is available from your Fluke Sales Representative.

Specifications

For complete specifications please refer to the pages in this catalog describing the 1752A and the following pages that describe the 2400B.

CRT Display: High contrast green phosphor, high resolution, 5x9 inch display screen. Sixteen lines of eighty characters or eight lines of forty characters, selectable by program control.

Transparent Touch-Sensitive Overlay: Positioned directly over the display screen. Provides a 6x10 array of touch-sense areas for dynamic operator interface.

Graphics Display: 640 by 224 dots, hardware sector generator.

Memory, 1752A: 136K bytes of RAM (expandable to over 2.6M bytes).

Memory, 2400B: 28K bytes of RAM for program storage.

Mass Storage

- Double-sided 5-1/4 inch floppy disk stores 400K bytes
- 800K bytes more with dual floppy disk drive (optional)
- 20M bytes with Winchester Disk (optional)

1752A Communications Interfaces: One IEEE-488 port and one RS-232-C port is standard. May be expanded to include six additional RS-232-C, RS-422, and/or 20 mA serial ports or a second IEEE-488 pport

2400B Interfaces: Three. One IEEE-488 port or one serial (RS-232-C, RS-422, or 20 mA) port, and two RS-232-C output-only ports.

Temperature: 10°C to 30°C, operating; -10°C to 60°C, non-operating (except floppy disks limited to 10°C to 52°C.

Relative Humidity: 5% to 80% operating, non-condensing; 5% to 95%, non-operating and non-condensing (except floppy disks limited to 8% to 90%).

Power: 90 to 132V ac or 180 to 264V ac, switch-selectable, 50 Hz to 60 Hz, ±2 Hz.

Size: 70.6 cm H x 61.0 cm W x 70.5 cm D (27.8 in x 24 in x 27.8 in)

Weight: 84 kg (185 lb) approximately, not including options.

2452MCS System Components:

- 1752A-1 with Keyboard
- Fluke enhanced BASIC Interpreter, Advanced Editor, File Utility Program
- ProLink II application software package (see page following for description)
- ProComm application software package (-03, -04 only) (see page following for description)
- 2400B with one each of Option -101, -102, -109, and -002 (or -001)
- Integral power strip and power cord
- Full set of Operator and Service Manuals
- 90-day on-site service

Model & Version	Rack Cabinet 71 cm (28") High	2400B Interface & 2 Meter Cable
2452MCS-01	Yes	IEEE-488 (Opt -002)
2452MCS-02	No	IEEE-488 (Opt -002)
2452MCS-03	Yes	Serial (Opt -001)
2452MCS-04	No	Serial (Opt -001)

The rack cabinet has a lockable storage drawer and keyboard drawer, a rear door, and associated hardware.

Ordering Information

Models

January 1989 prices

2452MCS-01	$14,800
2452MCS-02	$14,400
2452MCS-03	$14,800
2452MCS-04	$14,400

Options

See 2400B, page 421 and 1752A page 415.

Accessories (Also see page 485)

A24-89 71 cm Instrument Rack (28")	on req
A24-75 183 cm Instrument Rack (6')	on req
A24-90 Wheeled base, for A24-89 or A24-75	on req
A24-123 Serial Impact Printer w/RS-232-C I/F	on req
Y2055 15-Pin Multi-Connector for Multi-Drop RS-422 Hook-up ("Y" Connector)	95
1765B/20 20M-byte Winchester Disk Drive	3295
1761A External Disk Drive, 2x400k bytes	2950
1760A External Disk Drive, 400K bytes	1950

Service & Support

Warranty

90-day on-site product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2452MCS Repair (w/calibration)	1092
SC1-2452MCS Repair (cal w/in or out data)	1127
SC1-2452MCS Repair (cal w/in and out data)	1162
SC2-2452MCS Cal (1 per yr recommended)	207
SC2-2452MCS Cal (1 per yr w/in or out data)	242
SC2-2452MCS Cal (1 per yr w/in and out data)	277

ProLink II Application Software (S2400)

- Supplied with all 2452MCS Systems
- For use with Fluke 1722A/1752A and 2400B
- Simplifies development of 2400B application program
- Menu-driven user interface

Measurement & Control Software

Fluke offers a wide range of application software to help you develop your 2400B program.

Three of these software packages are designed to be used with the 2452MCS. They are Fluke ProLink II™ Application Software, ProComm™ Serial Communications Utility Package, and ProGen™ Application Software Package.

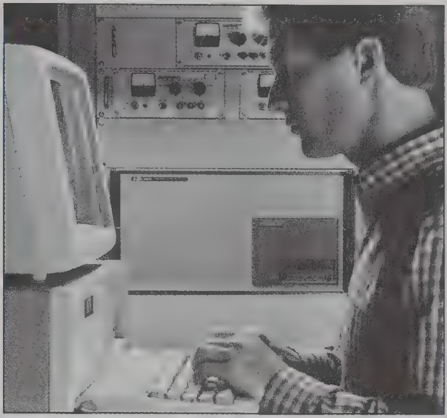
A fourth software development tool, ProLink PC,™ runs on your IBM PC,™ PC XT,™ or IBM compatible.

Fluke ProLink II Application Software comes standard with all 2452MCS systems. It is a tool which makes developing 2452MCS application program easier.

The 2452MCS consists of two independent computers: the Fluke 2400B and the 1752A Data Acquisition System. These two computers must talk to each other in order to do the job. Fluke ProLink II handles a lot of the system housekeeping tasks you would otherwise have to do. It presents you with a single user interface to both the 1752A and 2400B.

ProLink II presents the user with a menu of choices. You simply move the cursor to the proper selection and press the carriage return. This "one-touch" approach lets you do the following:

1. Automatically run Fluke BASIC; the File Utility Program which allows you to copy, move, delete or otherwise manipulate files; and SET, which allows you to set the RS-232C characteristics of the 1722A/1752A output ports. After exiting any of these three programs, you will automatically be returned to ProLink II.
2. Sends bus commands to the 2400B and displays responses to those commands.
3. Displays English language error messages if an error occurs.
4. Select, edit, download or retrieve user written 2400B programs.
5. Monitor selected variables during program execution. This function is very useful during the program debugging stage. You can download and run your 2400B program, and then monitor certain key variables. In this way you can ensure that variables are changing as you expect them to.
6. Print a hard copy of any file on an external printer.



ProComm Serial Communications Utility (S2417)

- Supplied with 2452MCS-03 and -04
- For use with 1722A/1752A and 2400B equipped with 2400B-001 serial I/F
- Implements serial communications between 1722A/1752A and 2400B, or multiple 2400Bs to single 1722A/1752A
- Provides built-in error detection and recovery capability
- Supports communications via modems as well as "hard-wired"

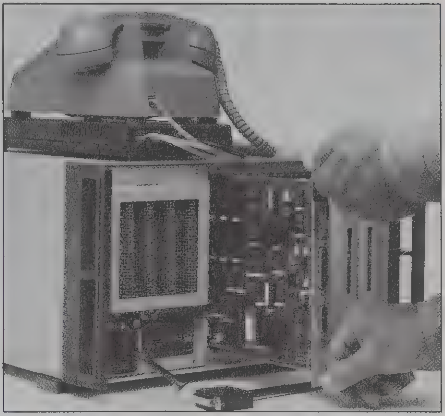
ProComm™ Serial Communications Utility Package comes standard with both serial versions of the 2452MCS, -03 and -04.

ProComm software is a utility package which implements serial communications between the 1722A/1752A and the 2400B Front End. The subroutines are callable from BASIC.

There are three functions which ProComm software can provide for you. If you are using an RS-422 or current loop transmission line, you can have more than one 2400B connected to your 1722A/1752A. This is called a multipoint system. ProComm software allows you to address and unaddress (terminate communications with) each 2400B in your system.

Second, ProComm software implements the highest level message transfer protocol supported by the 2400B, blocked format with acknowledgements and check character. This message transmission protocol provides your communications link with built-in error detection and recovery capability. It is especially useful in electrically noisy applications, or where you must guarantee the integrity of your data.

Third, if you are using a 2400B with an auto-answer modem across an RS-232C interface, ProComm software will automatically hang up the phone line on demand.



ProGen Application Software (S2452)

- For use with 2452MCS Systems
- Menu-prompted monitoring/controlling/logging program
- Requires no language programming knowledge to operate
- Supports up to 500 channels of input/output

ProGen Application Software allows user to get up and running quickly with the 2452MCS. It is a menu-prompted tool which actually programs the 2452MCS for you. Your 2452MCS can be monitoring and controlling your process or test in a short time.

ProGen software is compatible with all versions of 2452MCS, serial or IEEE-488. A 17XXA-007 512K byte RAM expansion option must be installed.

Fluke realizes that there may be one person who programs the application, and another who operates it. Accordingly, ProGen software has two separate disks: Programmer and Operator.

The person responsible for configuring the 2452MCS to meet the application uses the Programmer disk. This disk, in turn, creates the Operator disk.

The programmer is prompted to either "fill-in-the-blanks" or use the cursor control keys to move the cursor to the proper choice. Up to 500 channels can be monitored and controlled. In addition, you may select one of up to 100 user-defined limits lists of four limits each to apply to each channel.

The operator can change only those limits and setpoints which the programmer allows. The opdata, some data, or alarms only. Alarm data is automatically recorded.

ProGen software is the easy way to get your 2452MCS up and running.

Measurement & Control Software

ProLink PC Application Software (S2401)

- For use with IBM PC and Fluke 2400B Intelligent Computer Front End (serial communication)
- Simplifies development of 2400B measurement and control program
- Menu-driven user interface

ProLink PC is a menu-driven tool for developing 2400B programs with an IBM PC,™ PC XT,™ or IBM compatible. Similar in scope and function to ProLink II software, ProLink PC software will handle the communications between the two computers.

Your IBM PC must have an optional serial interface installed. Since the PC XT has this interface standard, ProLink PC software will operate directly on the XT. MS-DOS™ version 2.1 or higher is required.

The operator interface operates similar to ProLink II. The user is presented with a menu of choices. These choices allow you to do the following:

1. Set the RS-232C characteristics of the IBM communications ports.
2. Select, download, or retrieve 2400B programs.
3. Sends bus commands to the 2400B and display responses to those commands.
4. Displays English language error messages if an error occurs.
5. Monitor selected variables during program execution for program debugging.
6. Print a hard copy of a file on an external printer.
7. Exit ProLink PC to the IBM's operating system. The user can then use the editor EDLIN to edit his 2400B program.
8. Automatically set the date and time in the 2400B.

ProLogger 24 Application Software (S2402)

- For use with IBM-PC and Fluke 2400B Intelligent Computer Front End
- A program development tool and a data acquisition program

ProLogger 24 is a communications utility and a data acquisition program for the IBM Personal Computer and the Fluke 2400B.

As a communications utility this tool assists in the development of a 2400B program. It includes error decoding, downloading and retrieval of the program, a line editor for program modification, bus command interaction and real time block graphic display of a 2400B channel or variable.

As a data acquisition program it provides the ability to print and record to the IBM disk 2400B data. The data can be recorded as sent from the 2400B or in LOTUS 1-2-3™ format.

The key to the use of ProLogger 24 is the user defined macro. Macros are a series of 2400B bus commands that are executed on interval or on demand. ProLogger 24 can receive, display, record or print 2400B data. Data may be checked against limits. If a limit is exceeded the macro can execute another bus command, branch within the macro or trigger another macro. An alarm indicator flashes for unacknowledged alarms. An alarm transition log and an alarm status report is avail-able to the operator.

The IBM-PC, XT, AT or compatable must have a serial interface and MS-DOS 2.1 or higher. A color monitor is not a necessity, but will enhance the appearance of ProLogger 24. The IBM-PC needs 128K of memory, however, LOTUS 1-2-3™ will require additional memory. The 2400B option -001 and a serial cable.

ProLogger 24 allows full use of the 2400B stored program capability if desired.

Ordering Information

Software Packages

S2400*	ProLink II Application Software for 1722A/1752A	$295
S2401	ProLink PC Application Software for MS-DOS	295
S2402	ProLogger 24 Application Software for MS-DOS	295
S2417*	ProComm Serial Communications Package for 1722A/1752A	295
S2452	ProGen Application Software for 1722A/1752A	495

**Included with all 2452MCS Systems*
***Included with 2452MCS-03 and -04*

PM 8238

GPIB
IEEE-488

NEW

PM 8238

PM 8238 Multipoint Data Recorder

- Maximum 30 input channels, scanned at 10/s
- Graphic or numeric data presentation
- Optional alarm output plug-in cards
- Interpolation between measuring points for continuous line-plots
- Memory modules for user-program storage
- AX + B scaled measurements
- Maintenance free thermal printing

The PM 8238 is a 30 channel data recorder of the highest quality and reliability and is specifically designed to be set and left running for extended unattended operation. It offers real measurement versatility with features such as memory modules, which allow storage of settings. It can directly record voltage or temperature, with a wide choice of sensors in 2- or 4-wire configurations. Scanning takes only 100 ms/channel, for quick alarm detection. Individual measurement values are presented on a front-panel display: chart output can be numeric for clear presentation of values; graphic, for spotting trends; or both in combination.

Dependable Plotting, Durable Construction

The PM 8238 has been designed and constructed to give the highest quality and reliability in operation. Very reliable low noise reed relays are used for channel switching. The relays are tested to three times the normal operating life of the instrument. The number of components and PCBs is less than in similar instruments and the wiring has been reduced, cutting the chance of instrument failure; and special attention has been given to a rugged, durable construction. Quality and reliability is such that a high MTBF has been achieved.

Printing is by a high quality, maintenance free thermal print head. The user does not have to change pens, replace ribbons, fill ink reservoirs or clear inkjets. The head is virtually unaffected by dusty environments, ensuring sharp, quality plots throughout the life of the instrument.

To match the quality and reliability, the PM 8238 offers high accuracy and has a very broad spectrum of functions.

Systems Use

This instrument is ideally suited for unattended, preprogrammed operation, where the reliability is of maximum benefit. With optional IEC-625/IEEE-488 (GPIB) or V24/RS 232-C interfaces, operation in a computer controlled environment is possible. These allow various functions such as output of measured values to a computer/controller, remote control and set-up, presetting and programming and synchronized measurements. An optional extended TTL-control interface card provides remote control of some other functions such as chart speed, scan start, channel changing and printing event markers, all via TTL level signals. At any time, a complete survey of parameters can be requested.

Comprehensive Presentation Capabilities

The full scale definition of 1000 dots represents a resolution of 1 µV over the 250 mm (10 in.) plot width (at 1 mV span). Each channel is stamped with its number and the plots are date and time stamped if required, allowing easy archiving and copying of plots for distribution. Measurement speed is such that all 30 channels are scanned in 3s; this makes the PM 8238 ideal for real-time monitoring and control of many variables; it also provides for quick reactions to alarms. Because of the high speed, it can also be used for monitoring cause and effect on adjacent channels and for most applications, the plotting on such channels may be regarded as simultaneous. Charts are plotted on standard z-fold 250 mm (10 in.) wide thermal paper.

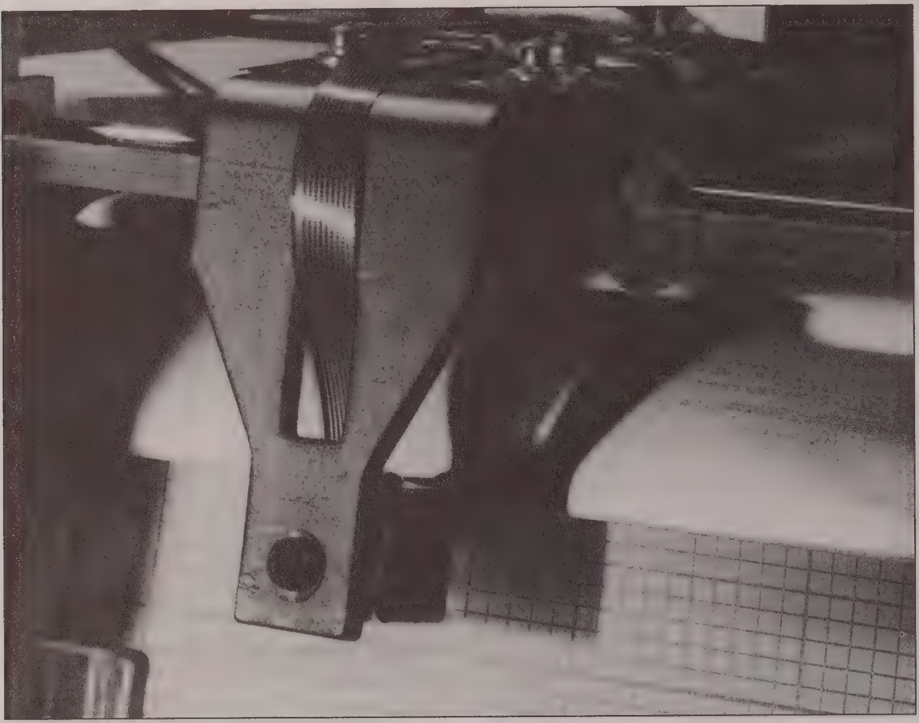
The AX + B scaling function allows display of the appropriate range for the variable: for example when operated with a humidity sensor, instead of displaying the mV output, that channel can be scaled to read from 0...100%.

In standby mode, input from the front panel or from a controller in a system set-up is directly recorded on the chart. Other information recorded on the chart includes chart speed; temperature at the isothermal input block for cold junction compensation; alarm points; functional units - V, °C or scaled; and the time of unexpected events such as power interruption. Dot density is alterable for each channel if the operator wishes one to be highlighted.

Numeric or Graphic Mode

Numeric mode directly outputs the values of individual measurements, in a 10-column tabular form, and this mode can be instantly selected at any time while recording. It can also

PM 8238



print out automatically, at user defined intervals of one minute from 1 to 99, allowing quick overviews of actual measurement results. Printouts include codes to show fault conditions such as out-of-scale, under-scale, thermocouple break or alarm conditions met.

Graphic mode gives optimum interpretation of results. It has a switchable interpolation mode that fills in dots between the actual measurement points. This gives continuous line plotting for direct detection of trends, peaks and irregularities. The fast measurement time (100 ms/channel) ensures the user can interpret events virtually in real-time. Comprehensive zero suppression facilities permit a flexible choice of scale positioning, so together with a chart speed continuously variable over 60 mm/min to 60 mm/h, optimum use is made of printout area. Multiple readings in the same range can be re-scaled for immediate comparisons. Direct plots can also be automatically made of the difference in measurements on different channels, speeding up comparisons and eliminating the potential for calculation error. A numeric print out can be selected automatically, while in graphic mode, at user defined intervals in steps of 10 minutes.

Simple Yet Versatile Operation

No previous knowledge of the instrument, or knowledge of software or programming are needed to operate this instrument. All tasks such as linearization and mixing of variable measurements on different channels are automatically handled by the recorder. PM 8238 can handle any combination of voltage or 2- or 4-wire temperature measurement on the maximum 30 channels (15 for 4-wire operation). Parameter settings are entered directly at the instrument keyboard, or from a remote PC or controller via one of the systems interfaces. All function keys have an LED to indicate activation. Keyboard settings are lockable to prevent accidental changes.

Programming is simple, via front panel keystrokes and clear error messages are provided. The range of possibilities for unattended operation is extended by the programming modules which can store settings. There is even a "copy channel" function for fast repeat programming.

Voltage Measurements

Choice of voltage ranges up to a maximum of ±30 V, with spans of 1 mV to 30V. The zero suppression facility allows the span to be located as a window over the selected range, and is entered by typing in the zero- and full-scale values of the window.

Temperature Measurement

Pt 100 uses the 4-wire connection, eliminating errors due to wire resistance; and the low 0.77 mA source current prevents self-heating.

For thermocouples three different forms of cold junction compensation are provided:

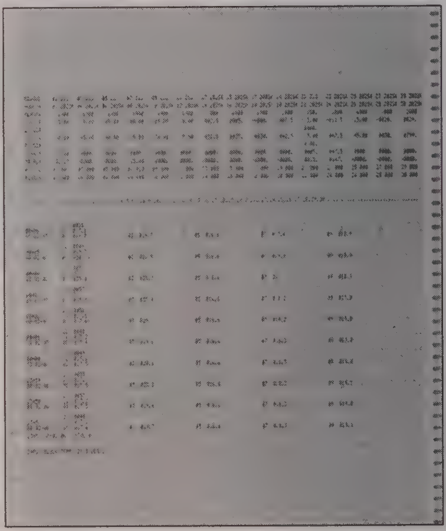
- automatic
- fixed at 0°C, 20°C or 50°C
- compensation from any other channel, eliminating the need for long compensation wires if the instrument is not near the measurement point.

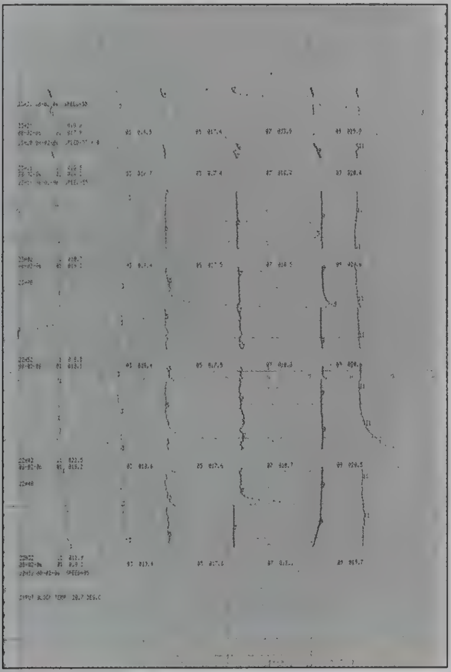
Cold junction compensation is achieved by a built-in isothermal block ensuring <$^1/_4$°C difference between terminals. The block is in a lockable compartment at the back, to protect it from any external effects such as direct heat radiation or convection. The difference measurement facility also helps eliminate cold junction errors; it automatically calculates the difference in readings beeen two channels, greatly reducing this type of inaccuracy (common to two channels).

Linearization is automatic for the 4 most common thermocouples: J-, K-, S- and T-type, with options for R-, B-, E-type, Nicrosil/Nisel and Ni-Ni. The zero suppression facilities described in the voltage measurement section are also available for temperature measurement. Error messages alert the operator if something goes wrong such as a break in thermocouple connection.

Alarms

The alarms may initiate one of several responses: e.g. increasing line intensity, print only on alarm or vary the chart speed. The PM 8328 unit provides for a maximum of two alarm cards to provide several alarm combinations. Slot 1 provides one minimum alarm and one maximum for odd numbered channels; slot 2 the same for even numbers. The cards simply plug-in and two common contacts for min/max values are provided.





Specifications

Technical Specifications

Voltage Measurements

Ranges and Spans:

Function	Permitted span	Full- and zero-scale limits	Range
mV	1...30 mV	-30...+30mV	30 mV
	5...300 mV	-300...-30 mV +30...+300 mV	300 mV
	50...3000 mV	-3000...-300 mV +300...+3000 mV	3000 mV
V	0.5...30 V	-30...+30 V	30 V

Accuracy: ±0.1% of input value ±0.1% of span
Temp. Coefficient of Accuracy: 0.2% of the input value per °C

Input:
Input Offset Voltage: <5 µV (= 1.25 mm at span of 1 mV)
Input Offset Voltage Drift: <0.5 µV/°C
Input Current: <100 pA
Input Impedance: 10 MΩ
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Possible Input Configurations: 2- and 4-terminal
Common Mode Rejection Ration (CMRR): >132 dB for DC
Series Mode Rejection Ration (SMRR): >38 dB for 50 and 60 Hz ± 1%
Measurement Time: 100 ms per channel

Thermocouple Measurements

Thermocouple Types:
J-type (Fe-Const)[1]
L-type (Fe-Const DIN)
K-type (Chromel-Alumel[1] + DIN)
S-type (Pt-Rh 10Pt[1] + DIN)
T-type (Cu-Const[1])
U-type (Cu-Const DIN)

[1] IEC 584-1, IPTS 68

Ranges and Spans

Type	Permitted span	Full- and zero-scale limits °C (see note)	Range
J, L	25...700 250...850	-200(-50)...+500 -100(-20)...+705	500 750
K	30...900 300...1470	-200(-50)...+700 -100(-20)...+1370	700 1370
S	250...1600	0...+1600	1600
T, U	35...600	-200(-50)...+400	0400

Note: The minimum input temperature above which full resolution (100 points) is obtained at the minimum span is indicated between brackets.

Accuracy (excl. Thermocouple): basic accuracy ± cold junction contribution ±0.1% of span

Basic Accuracy (over rated temp. range):

Type	Range	Basic Accuracy
J, L	500°C	±0.1%, T_{in} ±0.2°C (±0.55°C, T_{in} <50°C)
	750°C	±0.1%, T_{in} ±0.3°C (±0.4°C, T_{in} <-20°C)
K	700°C	±0.05%, T_{in} ±0.35°C (±0.75°C, T_{in} <-50°C)
	1370°C	±0.1%, T_{in} ±0.7°C (±0.8°C, T_{in} <-20°C)
S	1600°C	0.1% T_{in} ±1.3°C
T, U	400°C	±0.1%, T_{in} ±0.3°C (±0.6°C, T_{in} <-50°C)

Cold Junction Contribution: ≈ 1.2 x cold junction

Cold Junction Accuracy:
Measured Internally (Automatic): ±0.45°C ± 0.02(T_{amb} - 23)°C
Measured Externally (in Channel NN): Accuracy of external channel NN
Fixed (at 0°C, 20°C or 50°C): accuracy of external supplied temperature
Input Configurations: 2- and 4-terminal
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Measurement Time: 100 ms per channel

PT 100 Measurements

Pt 100 Temperature Measurement Current: 0.7685 mA
Span: 25...1050°C (span is the difference between the selected full-scale value FSV and the selected zero-scale value ZSV)
Full- and Zero-scale Limits: -200...+850°C
Accuracy (excl. Transducer): ±0.10% of T_{in} ± 0.25°C ± 0.06(T_{amb} - 23)°C ± 0.1% of span
Linearization: Acc. to DIN 43760/BS 1904: 1964
Input Configuration: 4-terminal input
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Measurement Time: 100 ms per channel

Resistance Measurements

Transducer Resistance: 0...3.9kΩ
Measuring Current: 0.7685 mA
Accuracy of the Current: ±0.015%
Temperature Coefficient of Current Source: 0.005% per °C
Input Configuration: 4-terminal

Differential Measurements
A channel X can be programmed to measure the difference relative to another channel Y

Alarm Relay (in PM 8238 and PM 9895)

Contact Ratings:
Switched Power: 10 W max.
Switched Voltage: 45 V_{DC} or 30 V_{AC} max.
Maximum Voltage between Contacts and Earth: 42 V_{DC} or 30 V_{AC} (rms)
Alarm to Contact Closure Time: depends on number of measured channels
Current through Closed Contacts: 2 A, DC or AC (rms) max.
Contact Resistance: 50 mΩ

General Specifications

Mains Voltage (Factory Set): 220...240 V_{AC} ± 10%; 110...127 V_{AC} ± 10%
Mains Frequency: 50 Hz ± 5% (can be set to 60 Hz)
Electrical Safety: Acc. to IEC 348 class 1; VDE 411 class 1
Dimensions (h x w x d): 284 x 352 x 444 mm (incl. feet)
Weight: Approx. 13 kg.
Climatic Conditions: Acc. to IEC 359, C1 tested acc. to IEC 68
Rated Temperature Range: operation within spec, +5...+50°C; limits of operation, 10...+50°C
Humidity: 20...80% RH non-condensing
Max. Dewpoint Temp: 26°C
Storage and Transport: Acc. to IEC 359; temperature -40...+70°C
Reference Conditions: Acc. to IEC 359; temperature 23°C ± 2°C; humidity 45...75% RH
Warm-up Time: 30 Minutes

Resolution:
Recording in Dot Mode: 0.1% of span (1000 points)
Recording in Numeric Mode: absolute value of the measured input with signal printed to four digits
Displayed Value: absolute value of the measured input with signal indicated to four digits.

PM 8238

Included with the instrument:

- package of 5 books of folded thermo-sensitive paper (20 m each), black imaging
- 2 fuses 1.6 A-T
- mains cord
- paper output tray
- program module
- operating manual "PM 8238 Multipoint Data Recorder"
- operating manual "PM 8238 Interfaces to other devices"

KS 8238 Industrialized Configuration

This multipoint recorder comes in two mainframe versions. The PM 8238 is designed for laboratory/bench top environments while the KS 8238 is designed for more industrial/systems environments. Both mainframe versions use the same internal hardware and software components. They differ only in packaging. The KS 8238 comes with all of the hardware necessary to panel mount standard. It also has a locking, gasketed front panel that covers the entire front of the instrument. This makes it more impervious to dusty and dirty environments as well as providing additional security against operator error. The KS 8238 also does not have a main power switch to make it easier to slave it off of the system power.

Ordering Information

Model

January 1989 prices

PM 8238/013 30 Channel Multipoint Recorder	$5500
KS 8238/013 30 Channel Multipoint Industrial Configuration Recorder	5950

Accessories

PM 9141/02 3 Program Modules	$175
PM 9838/20 19 inch Rackmount Unit	140
PM 9890/02 RS 232C/V24 Interface	800
PM 9891/02 IEC-625 Interface	950
PM 9893/01 Extended Control Interface	350
PM 9895/02 Alarm Relay Card for 15 channels	525
PM 9930A/03 5 books Z fold Paper, length 20m	90

Additional Thermocouple Linearization Units

PM 9897/03 Type R (0...1765C)	450
PM 9897/13 Type B (250...1820C)	450
PM 9897/23 Type E (-200...400C)	450
PM 9897/33 Type E (-100...1000C)	450
PM 9897/43 NiCrSi/NiSi (0...800C)	450
PM 9897/53 NiCrSi/NiSi (0...1200C)	450
PM 9897/63 Ni/Ni, 18% Mo (0...1400C)	450

Cables

Y1707 2m Cable for RS 232C	125
Y1705 RS 232C Null Modem Cable	75
Y8022 2m Cable for IEEE-488	145

Service & Support

Warranty

One and a half year warranty. (See page 470 for further information on warranty terms and conditions).

Note: The above configurations meet North American requirements. For other power options see page 491.

Operator Interfaces

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Fluke Touch Control Screens (TCS) are sophisticated operator interfaces for computer-based machinery or systems. With a minimum of training, operators can accurately and efficiently control even the most complex systems simply by touching the screen.

Our Touch Control Screens are used as the primary operator interface in applications such as production test systems, machinery control, and with bar code readers in data collection systems. In addition, many original equipment manufacturers of semiconductor fabrication machines, automated test equipment, and heavy industrial metal stamping presses use Fluke Touch Control Screens.

High reliability, rugged packaging, and ease-of-integration are just a few of the reasons manufacturers are choosing Fluke Touch Control Screens as their operator interface in harsh industrial environments.

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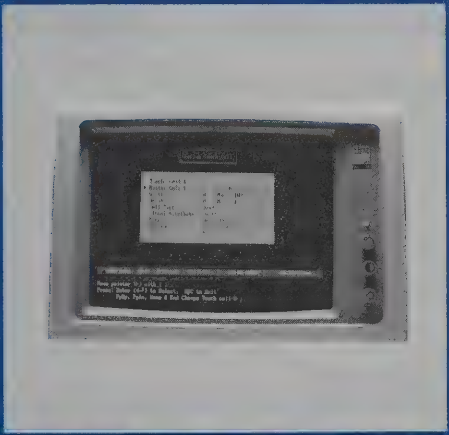
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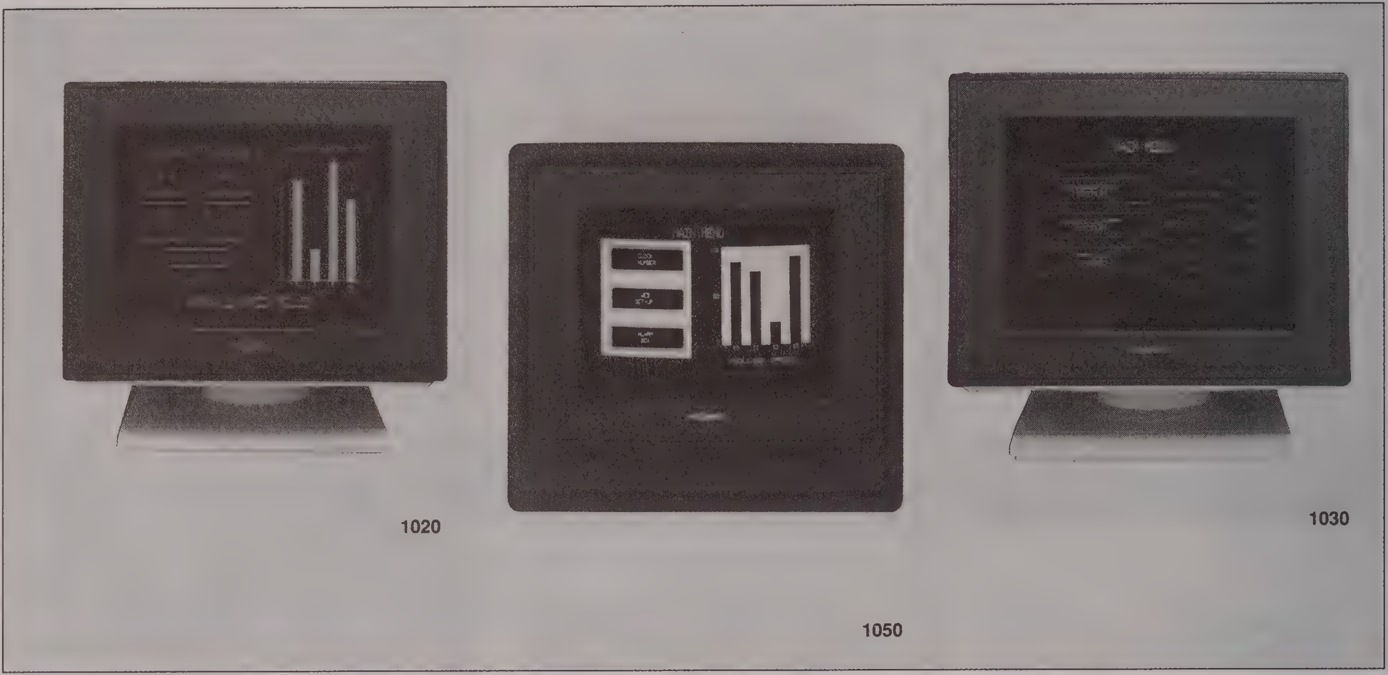
InfoTouch Display 433
Software Development Tools 434

Touch Control Screens



Touch Control Screens eliminate confusing sequences and memorization required by traditional control panels and terminals. Instead, they present a list of options to save training time and cost. Powerful built-in firmware makes these units simple to integrate into any computer-based machine or system.

The Fluke Touch Control Screen (TCS) offering is composed of three product series: The 1020 Series, the 1030 Series, and the 1050 Series. In addition, three software development packages are also available, ScreenBuilder™, IconBuilder™ and Touch Control Screen Toolbox™. The 1020 Series is a fully-integrated subsystem providing the benefits of touch control at a low price. The 1030 Series is a more advanced TCS offering Total Display Memory™ and the ability to multidrop 32 units on a single host serial port. Lastly, the 1050 Series provides all the high level functionality of the monochrome 1030 in a 12" color display.

Each series of products has a durable touch sensitive front panel, CRT, logic board, power supply, and mounting hardware. They are resistant to vibration and shock and sealed against moisture and dirt so they perform reliably in rugged environments. Based on over a decade of touch control experience, these screens bring the latest in technology to OEM applications and inhouse turnkey projects.

High Reliability, Low Cost, Operator Interfaces

- Touch Panel consists of 120 touch cells (12 x 10)
- Advanced programmiong commands
- Rack mountable
- Optional NEMA 12 panel mounting kit
- Selectable character attributes-highlight, blinking, reverse video, underline, conceal (or any combination of these)
- High contrast 12" CRT
- Full one year warranty
- OEM and quantity discounts

Touch Panel

The Touch Panel consists of transparent, conductive polyester sheets that form a switch matrix of 120 touch cells, each 2 lines high by 8 characters wide.

For increased resistance to chemical attack and abrasion, the touch panel is coated with a hardened anti-glare surface. The touch panel has been successfully tested to over 1 million touches.

Mechanical Integration

Mounting the TCS is as simple as cutting a hole, tightening mounting clips, and attaching the cables. For applications that require a drip-proof, dust-tight seal, a NEMA 12 Panel Mounting Kit is available. For easy installation in a standard 19" instrument rack, rack mount kits are also available.

Safety & EMI Standards

The Touch Control Screen is designed to comply with the following safety standards:

- ANSI/UL 478
- IEC 348
- IEC 435
- CSA 556B

The TCS has been verified to comply with the following EMI standards:

- FCC Part 15 Subpart J Class B
- VDE 0871

Diagnostics

Extensive diagnostic and self-test routines ensure the reliability of TCS operations. Whenever the TCS is powered-up or reset, an automatic self-test of ROM, RAM, non-volatile memory and touch panel ensures the integrity of its components.

1020 Series

The Fluke 1020 Series Touch Control Screens (TCS) are low price, menu-based operator interfaces for industrial applications. The Fluke 1020 and 1021 are both fully integrated subsystems. The Model 1020 includes a desk-top enclosure, a complete manual set, and an optional tilt-swivel base and amber display. The 1021, mountable into a panel or rack, can be installed with a NEMA 12 seal for use in harsh environments. The 1021 can include a fan for extending its operating temperature range.

Software Integration

The enhanced command set of the 1020 Series yields flexibility and programming ease. Region commands allow the programmer to create rectangular "touch targets" in a single command. Other commands allow the host to erase an entire region or modify the attributes within it. Characters can be displayed in reverse video, highlighted, blinking, underlined, or any combination of these. Touch panel commands allow the programmer to modify the way the 1020 or 1021 reports to the host that a touch has been made.

Communications

The 1020 and 1021 have an RS-232-C/RS-422-A serial interface that supports full-duplex communication and allows connection to the host computer directly or through a modem. Baud rates are selectable in standard increments up to 19,200. The TCS uses ANSI standard display codes (ANSI x3.64-1979) and is powered from standard ac line voltage.

1020

1020 Options

Amber Phosphor Display (1020-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 phosphor display is standard.

Tilt/Sivel Base (1020-31)

The Tilt/Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

1021 Options

Amber Phosphor Display (1021-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 phosphor display is standard.

Fan (1021-20)

An optional fan, including filter and filter cover, is available to increase the operating temperature range by 10°C.

Enclosure (1021-30)

An attractive plastic enclosure is available for operating the Touch Control Screen on a desktop.

Tilt/Swivel Base (1021-31)

The Tilt/Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

Accessories

Alphanumeric Keyboard (Y1000)

The Alphanumeric Keyboard is provided for programming or data entry applications with the Touch Control Screen.

NEMA 12 Panel Mounting Kit (Y1070)

This kit provides the gasketing and mounting hardware necessary to give the Touch Control Screen a NEMA Type 12 rating (drip-proof, dust-tight) when panel mounted in a suitable enclosure.

19" Rack Mount Kit (Y1080)

The Y1080 is the front panel to use when mounting the Touch Control Screen into a 482.6 mm (19 in) wide instrumentation rack.

19" Rack Mount Kit with 18" Slides (Y1081)

The Y1081 is used for complete slide-mounting of the TCS with 18" slides.

19" Rack Mount Kit with 24" Slides (Y1082)

The Y1082 is identical to the Y1081 except that it provides 24" slides.

Keyboard Extender Cable (Y1085)

The Y1085 is used to extend the keyboard interface to the front panel of the Y1080, Y1081, and Y1082 rack mounting accessories.

Contrast Enhancement Overlay (Y1090)

The Y1090 is a gray overlay that enhances visual contrast between the display background and characters on the Touch Control Screen.

1030 Series

RS 232

1030

1030 Series

The 1030 Series Touch Control Screens are advanced operator interfaces. A great amount of functionality is built-in to these units to reduce host computer requirements and simplify programming. The 1030 Series has two models: the Model 1030 and 1031. The 1030 is a fully integrated TCS with bench-top enclosure, a complete manual set, and one Expansion Memory Module for Total Display Memory™ capability. Optional tilt-swivel base and amber display are available.

The Model 1031 is mountable in a panel or rack. Optional NEMA 12 panel mount kit for use in harsh environments is available, as well as 19" rack mount kits. A fan may also be added to the 1031 to extend the operating temperature range. Up to 3 Expansion Memory Modules can be ordered with the 1031 for Total Display Memory capability.

Total Display Memory

Total Display Memory is a unique capability that not only stores the visual characteristics of each application screen, but also all "Touchkey" programming and screen attributes. This screen storage capability preserves complete screen functionality and allows stored screens to be edited without disrupting the currently displayed screen. Because the 1030 Series employs an efficient data compression algorithm, less complex screens require proportionately less memory. Also, the transition from one stored screen to the next is virtually instantaneous.

Total Display Memory is added to the 1030 Series by inserting up to three Expansion Memory Modules. Two memory types are available: EEPROM and Non-Volatile RAM. Only one memory type can be used in any single TCS.

Software Integration

The 1030 Series provides a set of commands to easily create "Touchkeys," which are a group of touch cells configured to function as a single button. Touchkeys are also easily outlined on the display for a target, plus can be created to automatically provide visual/audible feedback to the operator when any one of their touch cells has been activated. Other commands create bar charts, set scrolling regions, and modify character attributes. The 1030 Series also has the ability for the programmer to create custom characters and download them into the TCS's system memory.

Communications

The 1030 Series and the host computer communicate via serial interface supporting full-duplex RS-232-C, RS-422-A, and RS-485. RS-232-C is used most in normal environments. In noisy environments, or for distances of up to 1200m (4000') RS-422-A is recommended. RS-485 is used in multidrop configurations supporting up to 32 TCSs on one host serial port.

1030 Options

Amber Phosphor Display (1030-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 is standard.

Tilt-Swivel Base (1030-31)

The Tilt-Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

1031 Options

Amber Phosphor Display (1031-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 is standard.

Fan (1031-20)

An optional fan, including filter and filter cover, is available to increase the operating temperature by 10°C.

Enclosure (1031-30)

An attractive plastic enclosure is available for operating the TCS on a pedestal or bench-top.

Tilt-Swivel Base (1031-31)

The Tilt-Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

Expansion Memory Module - Non-Volatile RAM (1031-40)

Expansion Memory Modules allow the 1031 to store all application screens, touchkey programming, and screen attributes. Up to three 1031-40s may be installed in a single 1031.

Expansion Memory Module EEPROM (1031-50)

Expansion Memory Modules allow the 1031 to store all application screens, touchkey programming, and screen attributes. Up to three 1031-50s may be installed in a single 1031.

Accessories

Alphanumeric Keyboard (Y1000)

The Alphanumeric Keyboard is provided for programming or data entry applications with the Touch Control Screen

NEMA 12 Panel Mounting Kit (Y1070)

This kit provides the gasketing and mounting hardware necessary to give the Touch Control Screen a NEMA 12 rating (drip-proof, dust-tight) when panel mounted in a suitable enclosure.

19" Rack Mount Kit (Y1080)

The Y1080 is the front panel to use when mounting the Touch Control Screen into a 482.6mm (19 in) wide instrumentation rack.

19" Rack Mount Kit with 18" Slides (Y1082)

The Y1081 is used for complete slide-mounting of the TCS with 18" slides.

19" Rack Mount Kit with 24" Slides (Y1082)

The Y1082 is identical to the Y1081 except that it provides 24" slides.

Keyboard Extender Cable (Y1085)

The Y1085 is used to extend the keyboard interface to the front panel of the Y1080, Y1081, and Y1082 rack mounting accessories.

Contrast Enhancement Overlay (Y1090)

The Y1090 is a gray overlay that enhances visual contrast between the display back-ground and characters on the Touch Control Screen

Specifications

1020 and 1030 Series

Temperature: 0°to50°C withoutplastic enclosure; 0°C to 60° without plastic enclosure, with optional fan; 0°C to 40°C with plastic enclosure; 0°C to 50°C with plastic encolsure,with optional fan

Voltage: 90V to 132V ac, 180V to 264V ac, 47 Hz to 440 Hz

Size: 335.3 mm W x 260.9 mm H x 330 mm D (13.2 in W x 10.3 in H x 13.0 in D), with enclosure; 318 mm D (12.5 in D) without enclosure

Weight: 8.44 kg (18.6 lb) without plastic enclosure

Touch Panel: 120 Touch Cells, 12 rows x 10 columns; with hardened scratch resistant surface

CRT: 305 mm (12.0 in) diagonal, Monochrome P31 Phosphor (green); PC194 Phosphor (amber), option

Ordering Information

1020 Series

January 1989 prices

1020 Touch Control Screen Package (includes 1021, enclosure, manual set)	$1820
1021 Touch Control Screen	1695

Options (1020)

1020-10 Amber Phosphor Display	35
1020-31* Tilt/Swivel Base	80

** Customer installable*

Options (1021)

1021-10 Amber Phosphor Display	35
1021-20* Fan with cover and filter	95
1021-30* Enclosure	80
1021-31* Tilt/Swivel Base (used on 1021-30)	80
1021-90 1020 Series Manual Set	55

** Customer installable*

1030 Series

1030 Touch Control Screen Pkg (includes 1031, enclosure, manual set, 1 Expansion Memory Module NVRAM)	2330
1031 Touch Control Screen	2095

Options (1030)

1030-10 Amber Phosphor Display	35
1030-31* Tilt/Swivel Base	80

** Customer installable*

Options (1031)

1031-10 Amber Phosphor Display	35
1031-20* Fan with cover and filter	95
1031-30* Enclosure	80
1031-31* Tilt/Swivel Base	80
1031-40** Expansion Memory Module NV RAM	90
1031-50** Expansion Memory Module EEPROM	300
1031-90 1030 Series Manual Set	75

** Customer installable*

*** Only one type of Expansion Memory can be ordered per 1031. Up to three (3) of the chosen option may be installed per 1031*

Accessories (1020 and 1030 Series)

Y1000 Alphanumeric Keyboard	225
Y1060*RS-485 Multidrop Adapter Cable	60
Y1062 TCS Null Modem Cable	125
Y1070 NEMA 12 Panel Mounting Kit	40
Y1080 19" Rack Mount Kit	70
Y1081 19" Rack Mount Kit w/18" Slides	200
Y1082 19" Rack Mount Kit w/24" Slides	210
Y1085 Keyboard Extender Cable	60
Y1090 Contrast Enhancement Overlay	25
Y1707 2m RS-232-C Cable	125
Y1708 10m RS-232-C Cable	150

** For 1030 Series only*

Service & Support

Warranty

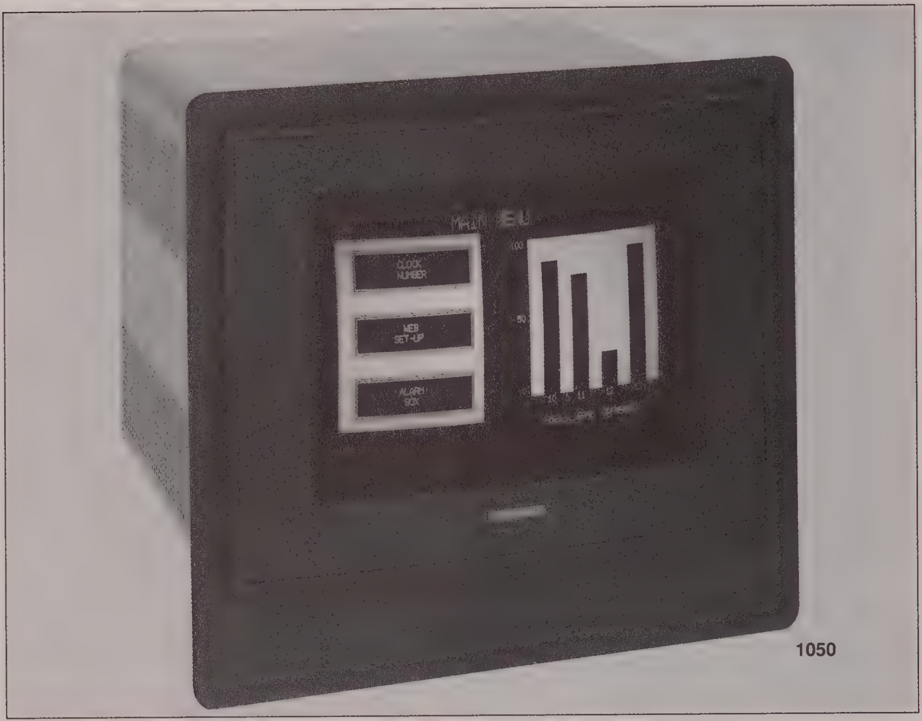
One-year product warranty. See page 470 for further information on warranty terms and conditions

Extended Warranty

SC1-1020 Repair	120
SC1-1021 Repair	120
SC1-1030 Repair	137
SC1-1031 Repair	137

1050 Series

RS-232



1050

1050 Series

The 1050 Series Color Touch Control Screen (CTCS) provides full color capability along with the same high level functionality of the 1030 Series. Up to 32 different colors can be displayed on any single 1050 screen. The 1050 Series has three models: the 1050 Color Touch Control Screen Package, the 1051 Color Touch Control Screen (panel mount), and the 1052 Color Touch Control Screen (rack mount).

The 1050 Series also has Total Display Memory™ capability, powerful firmware for ease of software integration, and multidrop capability of up to 32 CTCSs on a single host serial port. The 1050 Series meets NEMA 12 when panel mounted.

Specifications

1050 Series

Temperature: 0°C to 40°C without optional fan, 0°C to 50°C with optional fan
Voltage: 90V to 132V ac, 180V to 264V ac, 50/60 Hz
Touch Panel: 120 Touch Cells, 12 rows x 10 columns; with hardened scratch resistant surface
CRT: 305 mm (12 in) diagonal, 16 normal colors plus 16 highlight colors
Size: 1050/1051: 373.4 mm W x 345 mm H x 367.4 D. (14.7 in W x 13.6 in H x14.5 in D). 1052: 482.6 mm W x 355.6 mm eight rack units H x 370.8 mm D (19.0 in W x 14.0 in eight rack units high x 14.6 in D)
Weight: 15.6 kg (34 lbs)

Ordering Information

Models

January 1989 prices

1050 Color Touch Control Screen Pkg (Includes 1051, manual set, 1 Expansion Memory Module NVRAM)	$3655
1051 Color Touch Control Screen (panel mount)	3500
1052 Color Touch Control Screen (rack mount)	3600

Refer to 1030 Series section for descriptions of Options and Accessories.

Options (1051)

1051-20 Fan (with filter)	95
1051-40* Expansion Memory Module (Non-Volatile RAM)	90
1051-50* Expansion Memory Module (EEPROM)	300
1051-60 Custom Connector Extender Cable (Factory Configured)	95
1051-90 1050 Series Manual Set	75

Options (1052)

1052-20 Fan (with filter)	95
1052-40* Expansion Memory Module (Non-Volatile RAM)	90
1052-50* Expansion Memory Module (EEPROM)	300
1052-60 Custom Connector Extender Cable (Factory Configured)	95
1052-81 18" Rack Slide Kit	140
1052-82 24" Rack Slide Kit	150
1052-90 1050 Series Manual Set	75

** Only one type of Expansion Memory option can be ordered per 1051 or 1052. Up to quantity three (3) of the chosen option may be installed per 1051 or 1052*

Accessories (1050 Series)

Y1000 Alphanumeric Keyboard	225
Y1060 RS-485 Multidrop Adapter Cable	60
Y1062 TCS Null Modem Cable	125
Y1085 Keyboard Extender Cable	60
Y1707 2m RS-232-C Cable	125
Y1708 10m RS-232-C Cable	150

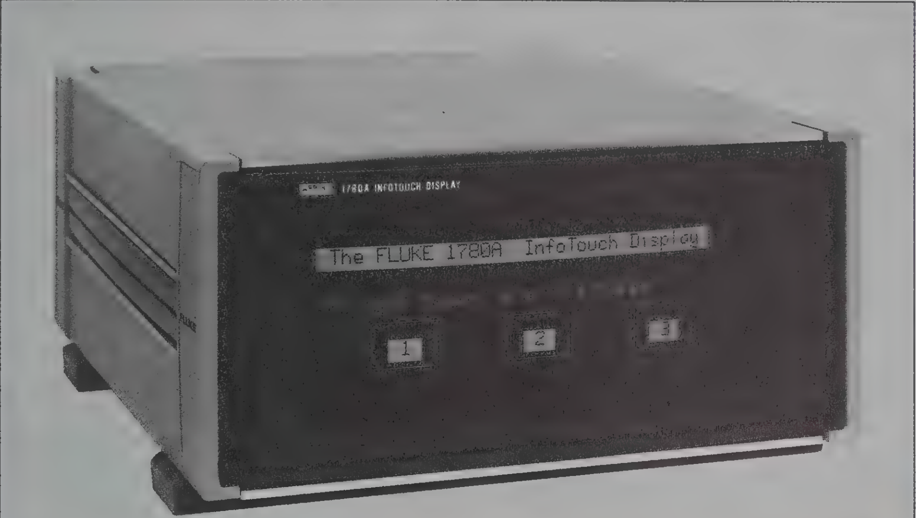
Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-1050 Repair	150
SC1-1051 Repair	150
SC1-1052 Repair	150



(NSN 7025-0-212-2063) **1780A**

1780A InfoTouch Display

- Compact, rugged packaging
- Operates with any computer via RS-232-C
- 60 fingertip-sized touch sensitive areas
- Crisp, alphanumeric and character graphic display

The 1780A provides a simple yet sophisticated means of interfacing an operator to a complex control process.

Whether the operator is highly skilled in a particular manufacturing or test process, or is a first-time or occasional user of an on-line information system, the 1780A is the ideal link between the user and the computer at the heart of your system. The 1780A's display screen is used to present choices to the operator, and the transparent, touch-sensitive switch matrix over-laying the display receives the operator's response to those choices. Complicated processes can be performed in a series of steps, each involving a small number of choices.

The InfoTouch Display eliminates the complexity of remembering and correctly entering system commands at a conventional keyboard. And since the operator can only act upon the choices presented to him on the display, the possibilities of error are greatly reduced. Information can be presented to the operator in numbers, letters, graphic messages, or custom symbols or alphabets. The touch-sensitive overlay covers most of the screen, and provides 60 fingertip sized touch areas.

Customizing the InfoTouch Display panel is a simple programming task of writing and storing sequences of ASCII characters and display control codes. Since the ASCII sequences are not dependent upon software language, the InfoTouch Display can be used with virtually any host computer. And since the displays are stored in your computer's software or firmware, changes can be easily made as you update the capabilities of your system.

The standard InfoTouch Display allows display of the full ASCII character set plus eleven standard graphics characters for creating simple line drawings or outlining touch-sense areas. Expanded graphics capabilities are optionally available via the 1780A-201 Expanded Graphics Character Set. This option provides 128 more graphics characters to let you generate complex process diagrams or other graphic displays.Or, if you like, you can customize the character sets for your particular system needs.

Optional Keyboard Interface

The Keyboard Interface Option (-001) gives the 1780A another input and output mode in addition to the touch sensitive screen. It may be used with a customized keypad, test fixture, or with the Y1720 Programmer Keyboard for operation as a standard terminal. There are also five TTL output lines on the interface which can be controlled through remote commands from the host.

Accessory Descriptions

Y1791 is a rack mount adapter with a blank filler panel. It allows the 1780A to be mounted to either the right or left side of standard 19-inch rack enclosures. Rack slides or a rack shelf are required for complete mounting of the 1780A in a rack.

Y1792 is a rack mount adapter with a keyboard extension cable. It is similar to Y1791 but includes an extension cable mounted to the filler panel which will extend the function of the 1780A-001 Keyboard Interface to the front panel. Rack slides or a rack shelf are required for complete mounting of the 1780A in a rack.

Y1793 is a carry handle that can be easily installed in place of the trim on either side of the 1780A.

Y1720 Full ASCII keyboard.

Specifications

Signal Emissions: Meets FCC Part 15, Subpart J, Class A
Temperature: 0°C to 50°C, operating; -40°C to +65°C, non-operating
Relative Humidity: To 95% from 0°C to 25°C, 75% to 40°C, and 45% to 50°C, non-condensing
Power: 90V to 132V ac, or 198V to 264V ac, 47 to 63 Hz, 55W maximum
Safety: Protection Class II per IEC 348
Size: 13.3 cm H x 28.8 cm W x 34.4 cm D (5.23 in x 11.35 in x 13.55 in). Standard 5-1/4-inch rack height
Weight: 9.7 kg (22 lb)

Ordering Information

Models

	January 1989 prices
1780A InfoTouch® Display	$2150

Options

-001* Keyboard Interface	155
-002* Keyboard Interface w/Y1720 Keyboard	415
1780A-201 Expanded Graphics Character Set	260

**Customer installable*

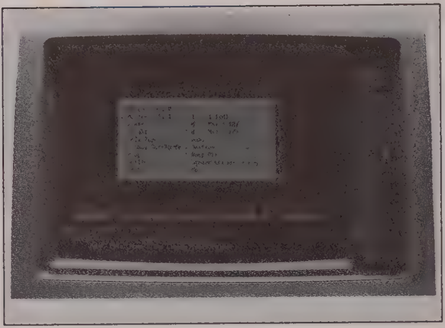
Accessories (Also see page 485)

Y1062 TCS Null Modem Cable	125
Y1707 2m RS-232-C Cable	125
Y1708 10m RS-232-C Cable	150
Y1720 Keyboard	350
Y1791* Rack Adapter	95
Y1792* Rack Adapter and Keyboard Cable	195
Y1793 Carry Handle	40
M00-260-610 18" Rack Slide Kit	130
M00-270-610 20" Rack Slide Kit	130
M00-280-610 24" Rack Slide Kit	130

**Separately order rack slides M00-260-610,M00-270-610, or M00-280-610*

Software Development Tools

NEW



Software Development Tools

Fast software integration is accomplished by three application development tools. All three run on the IBM family of Personal Computers (PCs) and compatibles.

- ScreenBuilder™
- IconBuilder™
- TCS Toolbox™

ScreenBuilder

ScreenBuilder is a development tool that allows the user to completely develop 1030 or 1050 stored screens simply by "filling in the blanks" on the PC. ScreenBuilder can be used as an "off-line" tool apart from the target system of the TCS application. In fact much of the screen development may be done without a TCS by viewing a representation of the screen on the PC monitor.

ScreenBuilder stores screens on a PC disk or in the TCS's optional memory.

ScreenBuilder features:

- Full support for all elements of stored screens. No additional programming is required to complete stored screens.
- Moving and editing of touchkeys, regions, and text.
- Complete control over characters attributes and colors* of touchkeys, regions, and text in any combination.
- Double-size, double-width, and normal size text.
- Hardcopy documentation for reference during host software development.

* *Color is only available on the 1050 Series of Touch Control Screens.*

IconBuilder

IconBuilder allows the user to create character fonts and icons for custom displays on the 1030 and 1050 Series TCSs. Much like ScreenBuilder, IconBuilder gives the designer the flexibility of creating and downloading apart from the target system. In use, TCS characters are enlarged on the PC screen so that each pixel can be edited. Once developed, these custom fonts and icons are stored on the PC disk or downloaded to the Touch Control Screen.

IconBuilder features:

- Juxtaposed character editing for creating icons.
- Character block moves for rearranging characters within a font.
- Easy character copying and replicating.
- Actual-size and enlarged character viewing on the PC monitor.
- Storage of all or part of the character font in the TCS or in "download files."
- Hardcopy documentation.

TCS Toolbox

The TCS Toolbox provides twelve unique functions that facilitate the development of a 1020 Series application program. Each individual function is called from QuickBASIC in a single program statement. Among the various routines are ones to place touchkeys, center and format text, automate numeric and alphanumeric data entry, and several to simplify touch report decoding. For fast debugging, complete error checking and reporting are performed. For customization, all source code is included.

The TCS Toolbox is best suited for 1020 Series Touch Control Screens. It uses only the low level functions supported by the 1020 Series, and works without screen memory.

Compatibility and Features

	TCS Toolbox	Icon Builder	Screen Builder
For Use w/1020	X	•	•
For Use w/1030	•	X	X
For Use w/1050	•	X	X
Creates Stored Screens	•	•	X
Creates Custom Fonts	•	X	•
Decodes Touch Reports	X	•	•

System Requirements

ScreenBuilder and IconBuilder:

- Fluke 1030 or 1050 Series TCS.
- IBM PC, PC/XT, PC/AT or equivalent.
  - 512K of memory (or more).
  - 5-1/4 inch floppy disk drive.
  - Serial port (optional but recommended).
  - Parallel printer port (optional).
  - Printer (optional).
- PC-DOS or equivalent, version 2.12 or later.
- Fluke Y1062 TCS Null Modem Cable or equivalent (a wiring diagram is included in the ScreenBuilder manual).
- VGA, EGA, CGA, MDA, Hercules or equivalent graphics card.

TCS Toolbox:

Same as ScreenBuilder/IconBuilder except for:

- Fluke 1020 Series TCS.
- 320K of memory (or more) in the PC.
- Microsoft QuickBASIC version 2.0 or later.

Ordering Information

Models	January 1989 prices
S1005 ScreenBuilder	$95
S1008 IconBuilder	95
102X-902 TCS Toolbox	95

Digital Thermometers

Page 437 52

Page 439 2170A

Page 440 2176A

Page 439 2165A

Page 444 2190A

Page 444 2180A

Fluke specializes in two basic kinds of digital thermometers: those that measure temperature using thermocouples and those that measure temperature using resistance temperature devices (RTDs). Fluke RTD thermometers are used when the greatest accuracy is required.

Fluke thermocouple thermometers range in style and purpose from handheld battery operated models (50 Series) used frequently by service technicians, to the more precise and versatile 2190A. The 2190A can be used with a printer and automatic scanner to record the temperature from many sensing points.

NOTE: Fluke data loggers should not be overlooked as temperature measurement instruments. They measure temperature using either thermocouples or RTDs from multiple points. Also, Fluke makes accessories for digital multimeters which allow temperature measurements.

Selection Guide 436
Handheld Thermometers 437
Panel Mount Thermometers 439
Portable & Rackmountable
Thermometers 439

Digital Thermometers

Selection Guide

	Panel Mount		Portable or Rackmountable									
Features	**2160A**	**2170A**	**2165A**	**2166A**	**2168A**	**2175A**	**2176A**	**2190A**	**2180A**	**2189A**	**51**	**52**
Page	**439**	**439**	**439**	**439**	**439**	**440**	**440**	**444**	**444**	**444**	**437**	**437**
Pt, Ni, Cu Type RTDs	—	—	—	—	—	—	—	—	All	Pt	—	—
NBS Type B, E, J, K, R, S, T, C T/Cs *	All	E,J,K,T	All	All	All	E,J,K,T	E,J,K,T	All	—	—	J,K	J,K
DIN Type J, T, T/Cs	No	No	No	No	No	No	No	Both	—	—	—	—
Measurement Resolution C	1°	0.1°	1°	1°	1°	0.1°	0.1°	0.1°	0.01°	0.01°	0.1°	0.1°
Number of Digits	4	4	4	4	4	4	4	5	5	5	5	5
Single Alarm Limits	—	—	—	—	—	—	—	-006	-006	-006	—	—
Selectable Input Points	1	1	1	10	1	1	10	1	1	1	1	2
Multipoint Selector, Manual	2161A	2161A	**	—	**	**	**	Y2001	Y2000	Y2000	—	—
Points Per Selector	10	10	**	—	**	**	**	10	10	10	—	—
Maximum Points	30	30	**	—	**	**	**	100	100	100	1	2
Batteries	—	—	-01	Y2004	Y2004	-01	Y2004	Y2009	Y2009	Y2009	Inc	Inc
External 12V DC Operation	—	—	—	Yes	Yes	—	Yes	Yes	Yes	Yes	—	—
Analog Output Option	-04	-04	-04	-04	-04	-04	-04	-002	-002	-002	—	—
Digital Output Option	-02	-02	-02	-02	-02	-02	-02	-002	-002	-002	—	—

**Type "C" is not an ANSI/ISA approved designation. It is used to designate Tungsten-5% Rhenium vs. Tungsten-26% Rhenium.*
***Works with 2161A Multipoint Selector except case style is different.*
[1] Also see 8520A/PRT Precision Thermometry Systems

Thermometry Product Summary

2160 and 2170 Series: Low-cost, high-accuracy digital thermocouple thermometers in either bench/portable or panel mount styles for applications requiring 1°or 0.1°resolution.

8520A/PRT: Best accuracy from -200 degrees C to +350 degrees C. A Rosemount Special 162N Platinum Resistance Thermometer Probe (PRT) and a Fluke 8520A 5 1/2-Digit Precision Multimeter having a built-in, customized linearization curve to match the specific PRT.

2180A, 2189A, and 2190A: Fluke's most accurate and versatile general purpose digital thermometers for RTDs or thermocouples. You may stack and latch each thermometer to a wide range of accessories, including manual multipoints, a battery pack, and a thermocouple calibrator.

50 Series: The 50 Series combine Fluke's technical expertise in low-cost handheld test instruments and laboratory-grade benchtop temperature instruments to create one of the most advanced, yet affordable, handheld thermometer lines in the industry.

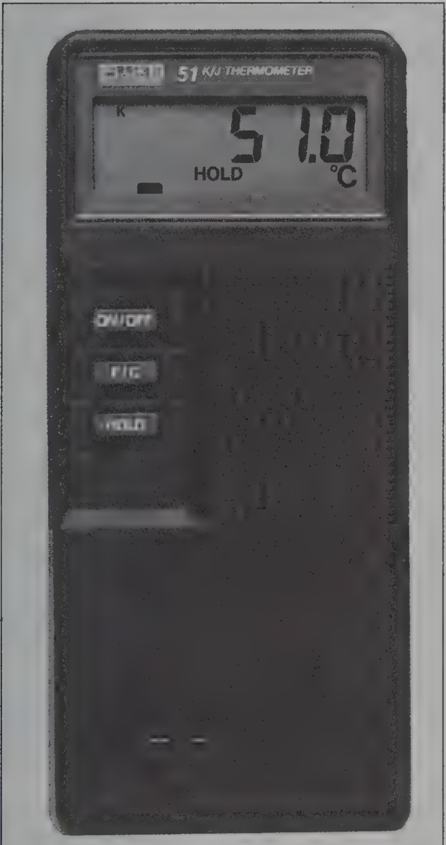
2300A Scanner: Designed to be used with a 2180A or 2190A Digital Thermometer. The 2300A will automatically scan up to 100 points of temperature, using either a 2180A and RTDs or a 2190A and thermocouples. The unit can also run under computer control.

Temperature Logging Systems: Choose from two models—one for RTDs and one for thermocouples. These factory-tested systems include a thermometer, scanner, and printer for precision temperature logging that is also portable.

2020A and 2030A Printers: Allow you to log data from a thermometer or a scanner and thermometer. The 2030A permits mX+b math scaling and trend plotting.

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Fluke 51 & 52



51

Fluke 50 Series Thermometer

- Self-test
- J or K-type thermocouples
- °C or °F display
- Reading hold function
- Single thermocouple input
- 1°C or 0.1°C (1°F or 0.2°F) resolution

The Fluke 51 & 52 Digital Thermometers are designed for high accuracy and resolution with excellent repeatability. Their price/performance ratio is unmatched in the industry. Reliability, a three-year warranty, and 1200-hour battery life combine to give users the lowest possible cost of ownership.

The Fluke 51 is a high quality, high performance Digital Thermocouple Thermometer. The most demanding users will get everything they expect and more from this rugged, single-input unit.

52

Additional for the Fluke 52

- Dual thermocouple input
- Differential temperature (T_1-T_2)
- Scan function (T_1, T_2, T_1-T_2,...)
- Min/Max record
- User-selectable resolution
- 1°C or 0.1°C (1°F or 0.2°F)

The Fluke 52 has several additional measurement functions and high-performance features. Dual inputs (T_1 and T_2) allow two individual points to be monitored, and provide information for the differential mode (T_1 minus T_2). A MIN/MAX register is available for any input (T_1,T_2 or T_1-T_2). At power-up the user can select a "scan" mode, which scrolls through the three modes in a T_1,T_2,T_1-T_2 continuous sequence. Also selectable at power-up is the choice of high resolution (0.1 degrees C or 0.2 degrees F) or low resolution (1°C or 1°F) readouts.

Specifications

Technical Specifications

Temperature Scale: Celsius or Fahrenheit user-selectable

Resolution: 1°C or 1°F (or 0.1°C or 0.2°F) user selectable

Thermocouple Types: K-type or J-type that conform to NBS and IEC 584 tables, user-selectable

Measurement Range: K-type range is -200°C to 1370°C (-328°F to 2498°F). J-type range is -200°C to 760°C (-328°F to 1400°F). Also check the rated range of the thermocouple to be used. For Fluke K-type probes see page 134

Meter Operating Range: For use in 0°C to 50°C environment (32°F to 122°F)

Meter Accuracy: Specified for a period of one year when meter is operated in an environment of 18°C to 28°C (64°F to 82°F). Thermocouple errors should be added to meter errors to determine measurement accuracy. See thermocouple manufacturer's data.or, for Fluke K-type probes, see page 134

Model	Accuracy ±(%of Rdg + °C)		Accuracy ±(%of Rdg + °F)	
	Type K	Type J	Type K	Type J
51 or 52	0.1% + 0.7°C	0.1% + 0.8°C	0.1% + 1.3°F	0.1% + 1.4°F
52* T_1-T_2	0.1% + 1.0°C	0.1% + 1.2°C	0.1% + 1.8°F	0.1% + 2.2°F

Typical accuracy only for T_1 minus T_2 temperature

Temperature Coefficient: Within the meter operating range, add to the meter accuracy specification 0.01% of reading +0.03°for each°below 18°C (64°F) or above 28°C (82°F)

Error Offset: Errors contributed by one particular thermocouple may be pratically eliminated, over a limited measurement range, using a recessed front panel OFFSET adjustment on the meter and an accurate temperature standard when making the adjustment. Although making that adjustment may increase measurement errors made using other thermocouples, the two-input Model 52 offers a means of adjusting one input and dedicating it to making particularly accurate measurements while using the other input for all other thermocouples

Input Connectors: For Standard miniature K-type or J-type polarized thermocouple plugs with flat, in-line blades spaced 7.9 mm (0.312 in) center to center

Maximum Input: 60V dc or 24V rms ac between the input pins or any input and ground. Maximum of 1V between inputs T1 and T2 on the Model 52

Reading Rate: 1 second per reading for one probe, 1.7 seconds per reading in the scan mode with the Model 52

Storage Temperature: -40°C to 60°C (-40°F to 140°F)

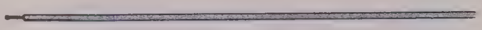
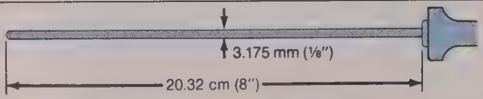
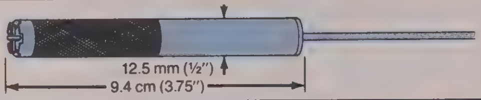
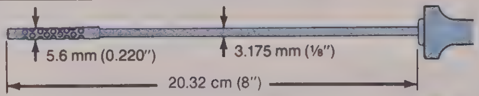
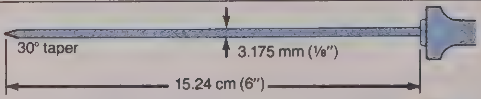
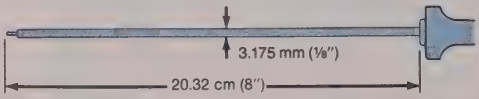
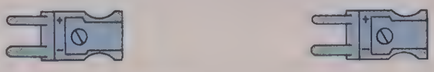
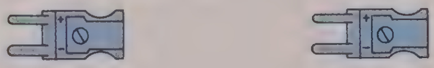
Relative Humidity: To 90% up to 35°C (95°F); to 70% up to 50°C (122°F)

Fluke 51 & 52

General Specifications

Battery: Standard 9V battery (NEDA 1604, 6F22, or 006P)
Battery Life: 1200 hours. Low battery indicator appears when less than 50 hours of battery life remain
Safety: Protection Class III as defined in IEC 348, Safety Requirements for Electronic Apparatus.
Size: 2.84 cm x 7.49 cm x 16.64 cm (1.12 in x 2.95 in x 6.55 in)
Weight: 280 gm (10 oz.)
Included: Battery, 80PK-1 probe for general purpose measurements (two with the 52), and operator's manual

K-Type, Thermocouples,
(See page 134 for specifications)

Model	Range	Style
80PK-1 Bead Air Probe	-40°C to 260°C (-40° F to 500°F)	
80PK-2A Inconel Sheath Immersion	-196° C to 927°C (-320°F to 1700°F)	
80PK-3 Surface Probe	-28°C to 260°C (-18.4°F to 500°F)	
80PK-4A Air Probe	-196°C to 816°C (-320°F to 1500°F)	
80PK-5 Stainless Steel Piercing Probe	-196°C to 927°C (-196°F to 1700°F)	
80PK-6A Exposed Probe	-196°C to 927°C (-320°F to 1500°F)	
80CK-M Male Type K Mini Connector (pkg. of 2) (20 AWG Max)	N/A	
80CJ-M Male Type J Mini Connector (pkg. of 2) (20 AWG Max)	N/A	

Ordering Information

Models

January 1989 prices

51 Digital Thermometer	$129
52 Digital Thermometer	169

Accessories (Also see page 485)

80PK-1 Bead Air Probe, -40°C to 260°C	12
80PK-2A Inconel Sheath Immersion Probe, -196°C to 927°C	36
80PK-3 Surface Probe, -28°C to 260°C	69
80PK-4A Air Probe, -196°C to 816°C	49
80PK-5 Stainless Steel Piercing Probe, -196°C to 816°C	36
80PK-6A Exposed Probe, -196°C to 816°C	43
80CJ-M Male Type J Mini Connector (pkg. of 2)	7
80CK-M Male Type K Mini Connector (pkg. of 2)	7
C25 Compact Soft Case for 50 Series w/ C70 holster	20
C50 Compact Soft Case	15
C70 Protective Holster	14
C100 Universal Hard Carrying Case	30

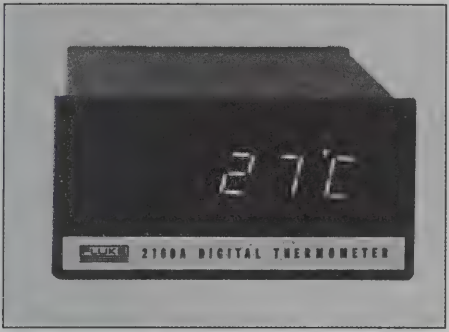
Service & Support

Warranty

Two-year product warranty. See page 470 for further information on warranty terms and conditions.

Available through Distributors (See page 500)

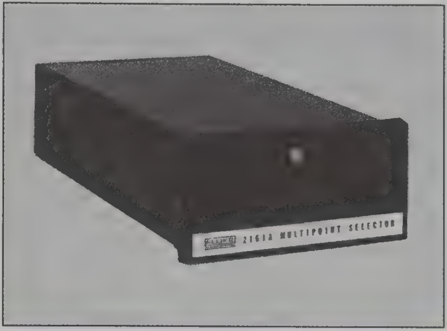
2160A & 2170A Series



2160A & 2170A Thermometer

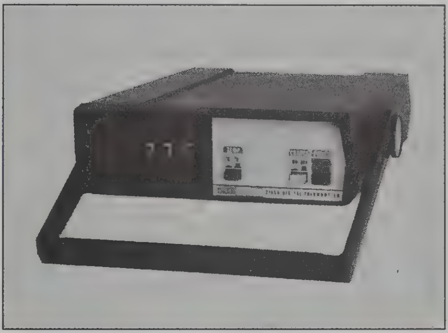
The 2160A and 2170A Thermometers are designed to be mounted in a panel. The panel opening required is a rectangle that is only 4.5 cm high by 9.2 cm wide, conforming to DIN Standard 43700. Both thermometers will indicate temperature in°Celsius or degrees Fahrenheit and an internal jumper is used to switch from one scale to the other.

The 2160A has a 1°C or 1°F resolution and uses any one of eight thermocouple types (J,K,T,E,R,S,B,or C). The 2170A has a 0.1°C or 0.1°F resolution and uses any one of four thermocouple types (J,K,T,or E). Both the 2160A and 2170 A are physically and electrically compatible with the 2161A Multipoint Selector.



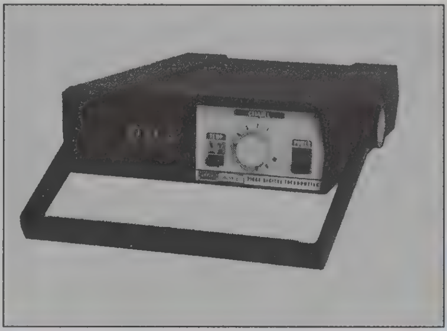
2161A Multipoint Selector

The Model 2161A Multipoint Selector is a panel-mounting, manually switched selector that allows 1 to 10 thermocouple probe of the same type to function as the input of the 2160A, or 2170A or other thermocouple thermometers. Two or more 2161As can be connected in series for monitoring more than ten inputs.



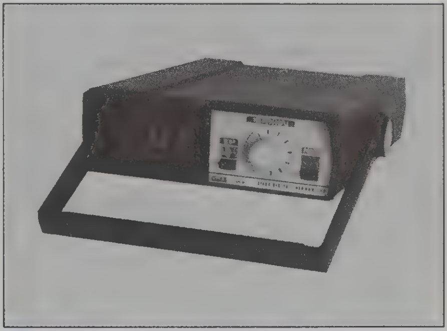
2165A Digital Thermometer

A single-point instrument in a rugged, portable case with specifications identical to the 2160A. It can be equipped with internal rechargeable batteries. Pushbutton controls include power (ON-OFF), temperature scale selection (°F/ °C), and battery charge (ON-OFF). Resolution is 1°F or 1°C.



2166A Multipoint Thermometer

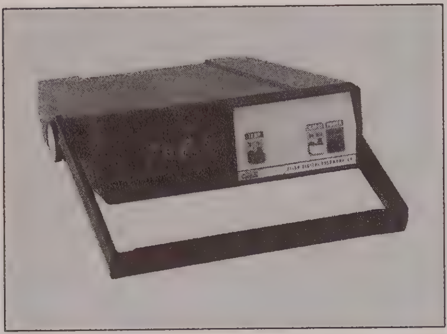
The 2166A is the same basic bench-type instrument as the 2165A but with the capability for monitoring up to 10 thermocouples of the same type. Thermocouple channel selection is by a 10-position front panel rotary switch. Power is either line voltage or external 12V dc (Y2004 Battery Pack has rechargeable batteries). Resolution is 1°F or 1°C.



2168A Multitype Thermometer

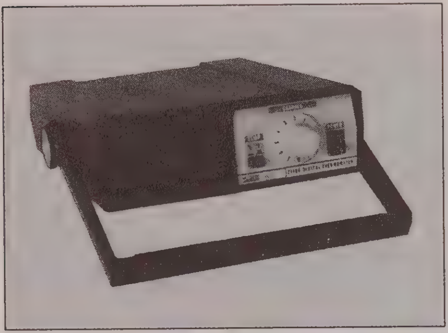
The 2168A is a portable, single-point instrument capable of accepting the output from any one of eight thermocouple types. Performance specifications are identical to the 2160A for each thermocouple type. Front panel controls include pushbutton power switch (ON-OFF) and temperature scale selection (°F or °C), plus an eight-position rotary switch for selecting thermocouple type. Power is either line voltage or external 12V dc (with Y2004 Carrying Case). Resolution is 1°F or 1°C.

2160A & 2170A Series



2175A Digital Thermometer

The 2175A is a single-point instrument in a rugged portable bench-mount case with the same specifications as the 2170A. It can be equipped with internal rechargeable batteries. Pushbutton controls include a power switch (ON-OFF), temperature scale selection (°F/°C), and battery charge. Resolution is 0.1°F or 0.1°C.



2176A Digital Thermometer

The 2176A is the same basic bench-type instrument as the 2175A but with the additional capability of monitoring up to 10 thermocouples (of the same type). Thermocouple channel selection is by means of a 10-position front panel rotary switch. Power is either line voltage or external 12V dc (with Y2004 Battery Pack). Resolution is 0.1°F or 0.1°C.

Specifications

Technical Specifications

Compatible Thermocouple Types:
2160A Series: J,K,T, E, R, S, B, C
2170A Series: J,K,T,E

Measurement Method: Dual-slope integration over a 100 ms period

Drift: None, automatic zero correction

Reading Rate: 2.5 readings per second

Conversion °C to °F: Jumper-selectable in panel-mount models, Switch-selectable on portable models.

Input Connections: Screw terminals on isothermal connector

Input Circuit: Two-wire, isolated

Input Impedance: 100 MΩ

Input Current: 500A

Source Impedance: 5 kΩ (5 kΩ causes <0.2°C error with K thermocouple)

Maximum Input Voltage: 400V dc or peak ac continuously, between inputs or either input and ground

Maximum Common Mode Voltage: 400V dc or peak AC

Common Mode Rejection: ≥120 dB at 50, 60, 400 Hz ±0.1% with 1 kΩ source impedance unbalance

Normal Mode Rejection: ≥60 dB at 50,60,400 Hz ± 0.1%

Overload: Display flashes when input voltage exceeds full-scale temperature range

Open Input: Display flashes to indicate open at input terminals

Response time: ≤2.0 second to rated accuracy

2160A Series Accuracy Specification

Thermocouple Type	Applicable Temperature Range °C	Maximum Error** (±°C)			Applicable Temperature Range °C	Maximum Error** (±°F)		
		Calibration Accuracy	90 Days 68 to 86°F	1 Year 59 to 95°F		Calibration Accuracy	90 Days 20 to 30°C	1 Year 15 to 35°C
J	-189 to 0	1	1.5	1.5	-328 to 32	1.5	2	2.5
	0 to 778	1	1	1.5	32 to 1432	1	1.5	2
K	-189 to 0	1	1.5	2	-328 to 32	2	2.5	3
	0 to 1356	1	1.5	2	32 to 2472	1.5	2.5	3
T	-189 to 0	1	1.5	2	-328 to 32	1.5	2	3.5
	0 to 400	1	1	1	32 to 752	1	1.5	2
E	-189 to 0	1	1.5	2	-328 to 32	1.5	2	3.5
	0 to 1000	1	1	1.5	32 to 1832	1	2	2.5
R	0 to 1756	1.5	2.5	3	32 to 3232	2	4	5
S	0 to 1733	1.5	2	3	32 to 3232	2	3.5	4.5
B	533 to 1800	1.5	2	2.5	992 to 3352	2	3.5	4.5
C*	0 to 2284	2	3	3	32 to 3999	3	5	5.5

**C designates Tungsten-5% Rhenium vs. Tungsten-26% Rhenium*

***Max. error includes NBS conformity, calibration, span, zero, reference junction, noise and stability, but not thermocouple errors. Add 0.1° C or 0.2° F for Model 2166A.*

2170A Series Accuracy Specification

Thermocouple Type	Applicable Temperature Range °C	Maximum Error ** (±°C)			Applicable Temperature Range °C	Maximum Error** (±°F)		
		Calibration Accuracy	90 Days 20 to 30°C	1 Year 15 to 35°C		Calibration Accuracy	90 Days 68 to 86°C	1 Year 59 to 95°C
J	-99.9 to 0	0.5	1	1.2	-99.9 to 32	0.9	1.6	2.1
	0 to 777.9	0.4	0.7	1.1	32 to 999.9	0.7	1.2	1.6
K	-99.9 to 0	0.7	1.2	1.5	-99.9 to 32	1.1	2.0	2.6
	0 to 999.9	0.5	1.1	1.4	32 to 999.9	1	1.4	1.8
T	-99.9 to 0	0.6	1	1.6	-99.9 to 32	0.9	1.7	2.9
	0 to 400	0.4	0.6	0.9	32 to 752	0.6	1	1.5
E	-99.9 to 0	0.6	1	1.7	-99.9 to 32	0.9	1.7	3.0
	0 to 999.9	0.5	1	1.4	32 to 999.9	0.8	1.3	1.8

**Max. error includes NBS conformity, calibration, span, zero, reference junction, noise and stability, but not thermocouple errors. Add 0.1°C and 0.2° F for Model 2176A.*

Option Specifications

Rechargeable Batteries (-01)

Used in Models 2165A and 2175A for portable-operations, and provides a continuous operating time of 8 hours. The internal batteries are rechargeable from line power in either trickle or full charge mode. They are field-installable at a later date.

Digital Output Unit (-02)

A field-installable option that provides a parallel BCD digital output equivalent to the displayed measurement date. Output data is solicited by and External Trigger and valid data is insured by Busy and Not Busy outputs. Output is fully buffered TTL/DTL compatible, isolated to 300V. A 6-foot ribbon cable and connector are included. Operates only when powered by AC line.

Analog Output Unit (-04)

A field-installable assembly which provides an output voltage of 1 mV per degree (Celsius or Fahrenheit) up to 4,000V (4000 degrees). Automatic polarity sensing is provided so that the polarity of the output voltage agrees with the displayed temperature. The output voltage is isolated from the input and referenced to the low terminal of the external voltmeter, stripchart recorder, etc. A 6-foot pair of wires and connector are included. Accuracy is ± 0.5% of reading ±1 mV. Operates only when powered by AC line.

General Specifications

Type of Display: LED
Shock and Vibration: Meets requirements of MIL-Std-810
Ambient Temperature: 0°C to 50°C, operating; -40°C to 60°C with batteries, -40°C to 75°C without batteries, non-operating
Relative Humidity: ≤90% from 0°C to 35°C, ≤80% to 50j°C, non-condensing
Line Operation: 115V ac ± 10%, 50 to 440 Hz, 8W (Bench), 4W (panel). 100V ac and 230V ac versions are also available
Battery Operation: Option -01 for the 2165A and 2175A operates eight hours on a full charge. Y2004 Battery Pack for 2166A, 2168A, and 2176A operates six hours on a full charge, typically
External DC Source: (2166A, 2168A, and 2176A)11 to 15V dc at 400 mA. Y2004 recommended
Size: (2165A, 2166A, 2168A, 2175A and 2176A) 6.4 cm H x 21.7 cm W x 25.2 cm D (2.52 in H x 8.55 in W x 9.9 in D)
Size: (2160A and 2170A) conforms to DIN standard 43700. 4.8 cm H x 9.6 cm W x 20.5 cm D(1.88 in H x 3.78 in W x 8.05 in D). Panel cutout is 9.2 cm x 4.5 cm (3.62 in x 1.77 in)
Weight
2165 and 2175A: 1.19 kg (2.63 lb) without batteries, 1.79 kg (3.95 lb) with batteries
2166A, 2168A, 2176A: 1.35 kg (3 lb)
2160A, 2170A: 0.74 kg (1.63 lb)
Warranty Period: One year
Included: Instruction manual, power cord. Thermocouple or thermocouple probe not included.

Ordering Information

Models

January 1989 prices

2160A Thermometer (panel-mount)	$440
2161A Multipoint Selector (panel-mount)	210
2165A Thermometer	575
2166A Thermometer (10 points)	680
2168A Thermometer (8 types)	810
2170A Thermometer (panel mount)	480
2175A Thermometer	675
2176A Thermometer (10 points)	800

**Thermocouples or probes not included. Specify thermocouple type to be used.*

Options (for 2165A or 2175A only)

-01* Rechargeable Batteries	95

Options (for all above Models)

-02** Digital Output (w/ cable)	180
-04** Analog Output (w/ cable)	235

** For 2165A and 2175A only*
*** Mutually exclusive in one instrument*

Accessories (Also see page 485)

See next page for Digital Thermometers Accessories

Service & Support

Warranty

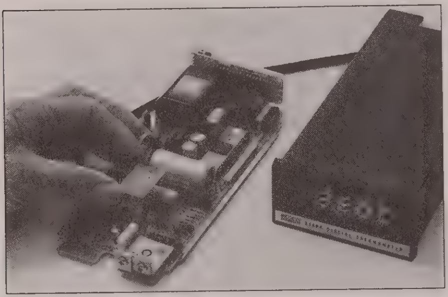
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty*

SC1-2160A Repair (w/ calibration)	$41
SC1-2160A Repair (cal w/in or out data)	76
SC1-2160A Repair (cal w/in and out data)	111
SC2-2160A Cal (1/yr recommended)	31
SC2-2160A Cal (1/yr w/in or out data)	66
SC2-2160A Cal (1/yr w/in and out data)	101
SC1-2161A Repair (w/ calibration)	31
SC1-2161A Performance Test only (1/yr)	31
SC1-2165A Repair (w/ calibration)	43
SC1-2165A Repair (cal w/in or out data)	78
SC1-2165A Repair (cal w/in and out data	113
SC2-2165A Cal (1/yr recommended)	31
SC2-2165A Cal (1/yr w/ in or out data)	66
SC2-2165A Cal (1/yr w/in and out data)	101
SC1-2166A Repair (w/ calibration)	52
SC1-2166A Repair (cal w/in or out data)	87
SC1-2166A Repair (cal w/in and out data)	122
SC2-2166A Cal (1/yr recommended)	31
SC2-2166A Cal (1/yr w/ in or out data)	66
SC2-2166A Cal (1/yr w/in and out data)	101
SC1-2168A Repair (w/ calibration)	82
SC1-2168A Repair (cal w/in or out data)	117
SC1-2168A Repair (cal w/in and out data)	152
SC2-2168A Cal (1/yr recommended)	31
SC2-2168A Cal (1/yr w/in or out data)	66
SC2-2168A Cal (1/yr w/in and out data)	101

**Extended Warranty available on other models also.*

Available through Distributors (See page 500)

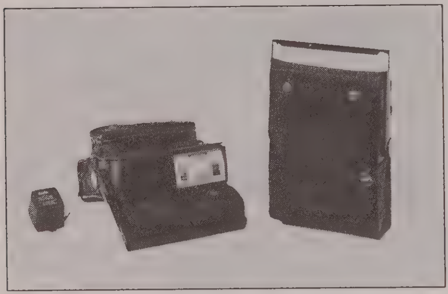


Thermocouple Type Conversion Kits

Your 2160-or 2170-Series Digital Thermometer may be equipped to work with only one type of thermocouple at a time. But it is very simple to convert it to be used with a different type thermocouple with an inexpensive conversion kit. Section II of your instruction manual tells how.

A conversion kit for a J, K, T, or E type thermocouple may be installed in any 2160 or 2170 Series Thermometer. In addition, a kit for a type R,S,B, or C may be installed in 2160 Series (but not the 2170 Series)

NBS Type	Conversion Kit No.	NBS Type	Conversion Kit No.
J	2160A-7016 $35	R	2160A-7012 $35
K	2160A-7017 35	S	2160A-7013 35
T	2160A-7018 35	B	2160A-7014 35
E	2160A-7019 35	C	2160A-7015 35



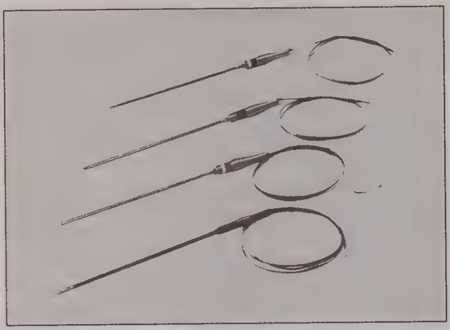
Y2004 Case and Battery Pack

The Y2004 consists of a case, 12-volt battery pack, and charger for use with the 2166A, 2168A, and 2176A. The Y8205 is a case only for any bench model 2160 or 2170 Series Thermometer. The Y2004 is especially recommended for the 2166A, 2168A, and 2176A Digital Thermometers because those models are not available with a self-contained rechargeable battery pack but have external 12-volt power connectors.

Typical operating time with batteries having a full charge is six hours. Recharge time at 25°C is approximately 15 hours.

Y2004 Carrying Case/Battery Pack & Charger	$205
Y8205 Carrying Case	35

P20 Series Thermocouple Probes

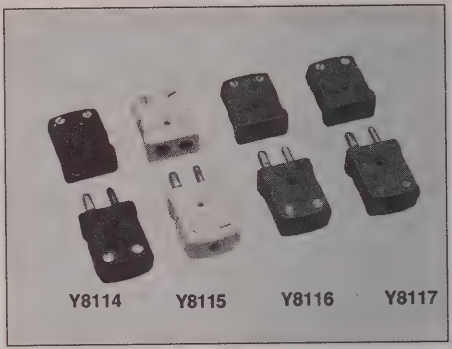


These probes are ANSI Standard accuracy general prupose immersion type probes. They have sheaths 6-inches long by 1/8-inch diameter made of INCONEL.

The thermocouple lead wire is three feet long and its insulation will withstand temperatures up to 480°C continually. Inside the sheath, the wires are insulated with magnesium oxide but are grounded to the sheath at the junction. They are particularly intended for use with Fluke 2190A Digital Thermometers and the 2160-Series, 2170 Series Digital Thermometers.

The 80PK, Type K Series Probes shown on page 134 can also be used with the 2160 Series, 2170 Series, and 2190A Digital Thermometers by simply cutting off the attached thermocouple plug and attaching the bare end of the wires to the thermometer inputs.

Type	Useful Range
P20J $63	-150° to 875°C
P20K 63	-150° to 1260°C
P20T 63	-150° to 400°C
P20E 63	-270° to 1000°C



Thermocouple Probe Extender Connectors

Matching thermocouple connectors should be used to extend length of leads when using thermocouple probes. Connectors and 100-foot lengths of #20 AWG thermocouple wire are available. Connectors are made of thermocouple material and should match the type of thermocouple wire.

NBS Type	Probe Type	Mating Connectors	Thermocouple Wire (100 ft.)
J	P20J	Y8114 $16	Y8110 $68
K	P20K	Y8115 16	Y8111 115
T	P20T	Y8116 16	Y8112 115
E	P20E	Y8117 16	Y8113 115

8520A/PRT

GPIB
IEEE-488

(NSN) 6625-01-136-9346) **8520/PRT**

8520A/PRT Temperature Measurement System

- -183°C to + 350°C (IPTS 68) range
- ±0.010°C accuracy - 100°C to + 100°C
- 0.001°C resolution
- Reading storage memory
- GPIB/IEEE-488 interface
- Onboard computational programs
- Full DMM capability

The 8520A/PRT is a temperature measurement system consisting of a special Rosemount* 162N Platinum Resistance Thermometer (PRT) and a Fluke 8520A 5-1/2 Digit Precision Digital Multimeter. The 8520A contains a built-in linearization program customized to match the calibration curve of the specific PRT supplied. Temperature is indicated directly in either °C, °F or K with 0.001° resolution.

The system provides a fast, low-cost way of making extremely accurate temperature measurements, or calibrating temperature measurement instruments, in the range of -183°C to +350°C. Systems using four-terminal resistance bridges are much more time-consuming to use, require greater expertise, are limited in their applications, and are far more costly.

Measurements are repeated approximately once per second, making it possible to detect and track fast temperature changes, something impractical to try to do with balance bridges.

**Rosemount® is a trademark of Rosemount, Inc.*
Note: The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

162N PRT Characteristics

All PRTs exhibit hysteresis during temperature cycling, as with going from room temperature to boiling and back. The special 162N has a hysteresis of less than 0.001% of the temperature span. That is less than 1 mK for the entire thermometer range. This quality is not achievable in any industrial PRT.

Errors due to a change in ice-point resistance can be detected using a standard 100-ohm resistor (supplied), and the change can be compensated easily by changing the gain factor in a memory register of the 8520A. Such compensation is completely effective near 0°C, least effective near -110°C and +240°C, but predictable as a worst-case error at all temperatures within the range of -183°C to +350°C.

8520A Characteristics

The 8520A Digital Multimeter is compatible with GPIB/IEEE-488* instrument systems and has both built in and optional math power for a wide range of R&D and ATE applications other than temperature measurement and calibration. See page 77 for more information.

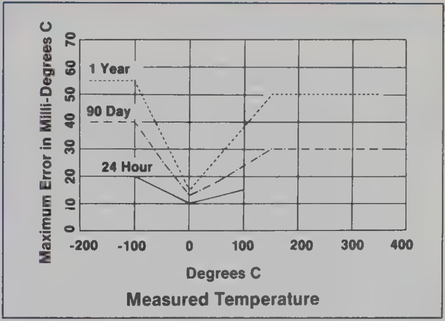
Accuracy

The temperature measurement accuracy of the 8520A/PRT system is shown graphically in the accompanying chart. Because accuracy depends on the stability characteristics of the 8520A as a function of both ambient temperature and time, 24-hour, 90-day, and 1-year accuracy curves are shown. The kind of accuracy you need will determine how often the 8520A should be calibrated.

The stability characteristics of the PRT are also very important and are influenced by time, how carefully it is used, and the kind of use it gets.

The 162N Probe is calibrated in liquid baths. No significant error due to self-heating will occur when measuring the temperature of liquids. A +12 mK error should be expected when measuring the temperature of gases.

Specifications



Probe Sheath: INCONEL-X750, 5.6 mm (0.219 in) diameter, 48 cm (19 in) length
Connector: Mates with 8520A/PRT
Power: 100, 120, 220, or 240V ac, ± 10%, 50 to 60 Hz, ≤50W
Size: 8.9 cm H x 47.7 cm L x 43.2 cm W (3-1/2 in H x 18 in L x 17 in W)
Weight: 9.56 kg (21 lb)

Ordering Information

Model	January 1989 prices
8520A/PRT Temperature Measurement System w/Probe	7350
Option	
8520A-010* Extended software pkg	600

2180A, 2189A & 2190A

GPIB
IEEE-488

RS-232

2189A Thermometry System

2180A, 2189A & 2190A TemPak Series

- 0.01° resolution for the 2180A and 2189A and 0.1° resolution for the 2190A
- Capable of running off of 12V dc or ac line power
- Designed to be integrated with a wide variety of instruments and accessories
- °C of °F is selectable via a front panel switch
- A full five digit LED display
- Analog and digital (RS-232-C or GPIB/IEEE-488) output options are available
- The limits option allows peak and valley memory, alarms and delta
- The 2189A consists of a 2180A and plantinum RTD probe for greater accuracy
- 6 different RTD types are switch selectable. 4 platinum, 1 nickel, 1 copper (2180A)
- 15 different thermocouple linearizations including 2 DIN and 3 JIS standards (2190A)

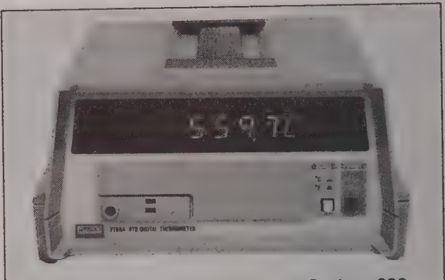
Fluke's most accurate and versatile general purpose digital thermometers are the 2180A and 2189A for RTDs and the 2190A for thermocouples. State-of-the-art accuracy teams with a large family of options and accessories to let you make precision temperature measurements in the lab or out in the field.

The 2180A RTD Digital Thermometer lets you switch-select one of six different types of RTDs, four platinum, one nickel, and one copper. Resolution is 0.01 degrees.

The 2189A Thermometry System consists of a 2180A that is factory-matched to a precision Y2039 Platinum RTD Probe.

The 2190A Thermocouple Digital Thermometer supports ten different thermocouple types, including two that comply to European DIN standards and three to Japanese standards. Resolution is 0.1 degrees. Take your choice from three different standard combinations of thermocouple types.

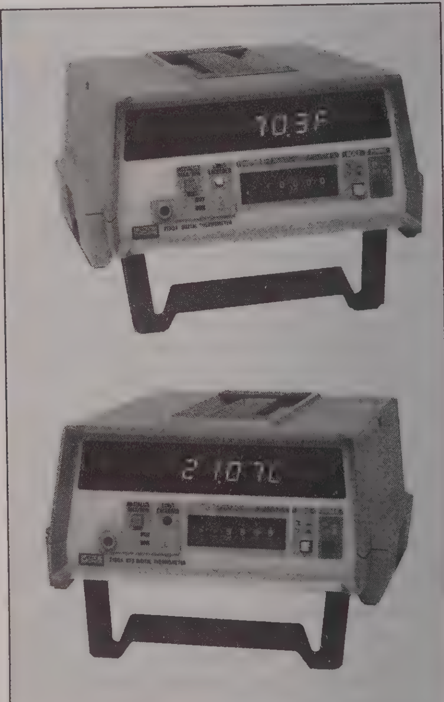
Each thermometer features a bright, high resolution LED display with pushbutton selection of Fahrenheit or Celsius readings. Each is capable of being run from either ac line power or external 12V dc, for field portability.



2180A without Option -006

Output Option -002, -004 and Limits Option -006 are usable with any of the three thermometers. Other accessory items electronically connect and stack and latch to the 2180A or 2190A. These include manual multipoints, multiple alarms, a battery pack, and a thermocouple thermometer calibrator. Some are also practical to use with the 2189A.

For automatic scanning, see the section on the 2300A Scanner. A 2020A or 2030A Printer allows you to permanently store data when used with a 2180A or 2190A configured with an output option. Portable temperature logging is available with the factory-tested Temperature Logging Systems — 2383A or 2393A.



2190A/2180A with Option -006

Limits Option (-006)

This option adds three powerful functions to the 2180A and 2190A Thermometers: Alarms, Peak Memory, and Delta. The Alarms function lights an indicator and closes a relay to activate external devices whenever a single preset maximum or minimum set-point is exceeded. Peak Memory stores the highest and lowest temperature reading for later recall. And Delta automatically subtracts a thumbwheel setting from the actual measurement and displays the difference.

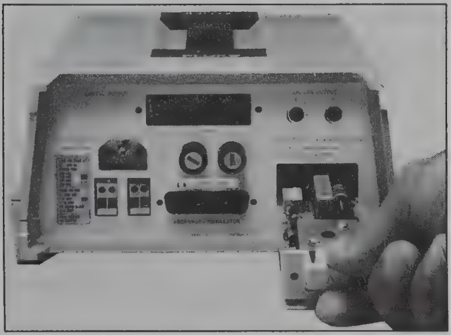
IEEE-488 Option (-004)

The 21X0-004 is an GPIB/IEEE-488* output option for the 2180A, 2189A and 2190A thermometers. This option mounts within the thermometer in the same location as the 21X0A-002. Readings are taken in response to an SRQ from the option by an IEEE-488 controller. This interface option does not include analog output capability. For applications requiring analog output and IEEE-488, use Option -002, 2XXXA-522, 1120A and Y7203. Not for use in a 2300A Scanner System.

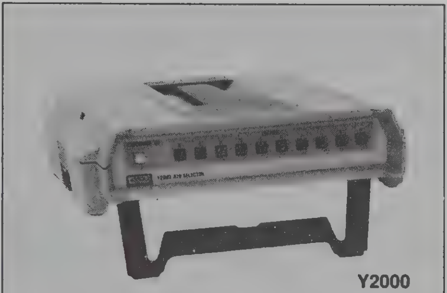
Output Option (-002)

For recording temperature measurements with a 2180A, 2189A, or 2190A, you can use Output Option -002. It provides both an analog output for chart recorders and a digital output for printers or computers, and may be installed in the field. The digital output is available in four forms, depending on connector pins and cabling used: Parallel ASCII, RS-232-C, TTY current loop, and IEEE-488 (using the Fluke 1120A Translator). The Y2026B RS-232-C Cable Adapter is available to convert the 36-pin PTI connector on the option to a standard 25-pin RS-232-C connector, or the user can wire his own cable to the connector provided.

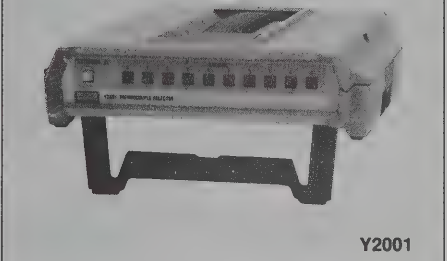
Option -002 is required when the thermometer is being used with a Fluke 2020A-004 or 2030A Printer unless a 2300A Scanner is used.



Rear view of 2190A showing the (A) Output Option -002 Connector, (B) Y2030 Thermocouple Input Module, and (C) Limits Option -006 Relay Output.



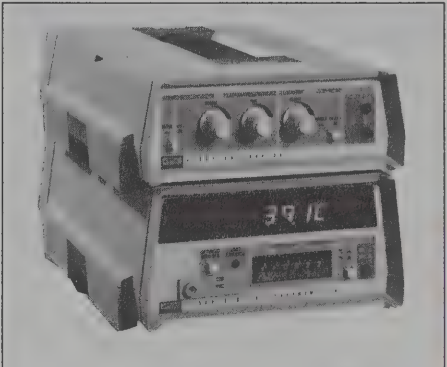
Y2000



Y2001

Multipoint Selector (Y2000 & Y2001)

The Y2000 RTD Multipoint Selector (for the 2180A) and the Y2001 Thermocouple Multipoint Selector (for the 2190A) increase the number of points your thermometer can monitor. Connect up to ten sensors to each multipoint selector. Cascade up to ten multipoint selectors for up to 100 measuring points—all using a single 2180A or 2190A Thermometer. Both units have ten pushbuttons to easily access a specific measurement point. To measure or monitor more than one type of RTD or thermocouple, take advantage of internal switching. This allows you to monitor five sensors of one type, five of another. With Output Option -002 or -004 installed, the channel number is sent to your printer or computer, too. For automatic scanning applications see the 2300A, 2383A and 2393A.



The 2190A/Y2003 Portable Calibration System

Thermometer Calibration (Y2003)

The Y2003 Thermometer Calibrator and 2190A Digital Thermocouple Thermometer can be used together to check the accuracy of a thermocouple or millivolt-measuring or recording instrument.

Accurate and completely portable, the Y2003-2190A combination provides a variable voltage output from -10mV to +90mV. The output voltage simulates a thermocouple output, so that the reading on the 2190A Thermometer can be compared with a corresponding reading on any other thermocouple thermometer, either analog or digital. In addition, the Y2003 and 2190A can be used to calibrate millivolt chart recorders and digital or analog indicators measuring to 90 mV. Besides being used as a portable calibration system, the Y2003 can be used as a battery pack for the 2190A. See Y2009 below for battery usage details. For more information ask for Bulletin B0059.

Y2009

Battery Pack (Y2009)

The Y2009 Battery Pack is a rechargeable, self-contained 12V dc nickel-cadmium supply for up to five hours of continuous operation. An indicator light tells you when batteries are low, while an automatic cut-off prevents damage to the cells from excessive discharge.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

2180A, 2189A & 2190A

Specifications

2180A & 2190A Specifications

2180A RTD Thermometer

RTD Types: 100Ω Pt, 385 (DIN), 390, 3916, or 392; 100Ω Ni (DIN); 10Ω Cu; 0 to 999Ω resistance — switch-selectable

Resolution: 100Ω Pt RTDs: 0.01°, autoranging to 0.1° above 204°C; 100Ω Ni RTDs: 0.01°, autoranging to 0.1° above 93°C; 10Ω Cu RTDs 0.1°.

Input Connection: 4-wire screw terminals. Terminals accept 3-wire and 2-wire RTDs at reduced accuracy

RTD Matching: User-performed potentiometer adjustment matches the 2180A to user's RTD to compensate for variations in lead length and resistance at 0°C

Lead Resistance: 4-wire: 200Ω max per lead for both 100Ω and 10Ω RTDs; 3-wire: 2Ω max per lead for 100Ω RTDs, 0.18Ω max per lead for 10Ω RTDs; 2-wire; 0.9Ω max per lead for 100Ω RTDs, 0.09Ω max per lead for 10Ω RTDs

Lead Resistance Error: 4-wire; no error, 3-wire 100Ω RTDs: 0.012° per degree per ohm; 3-wire 10Ω RTDs: 0.12° per degree per ohm; 2-wire 100Ω RTDs: 0.025° per degree per ohm; 2-wire 10Ω RTDs 0.25° per degree per ohm

2180A Linearizations (Type 2)*

RTD Type	Linearization Coefficients
100Ω 385 Pt	DIN**43760 Table
100Ω 390 Pt	ALPHA* = 0.0038994 DELTA* = 1.494 A4* = -0.265668×10^{-4} C4* = $-0.205984 \times 10^{-11}$
100Ω 3916 Pt	ALPHA* = 0.003916 DELTA* = 1.505 A4* = -0.099668×10^{-5} C4* = $-0.271142 \times 10^{-12}$
100Ω 392 Pt	ALPHA* = 0.0039221 DELTA* = 1.493 A4* = -0.38668×10^{-5} C4* = $+0.192912 \times 10^{-13}$
100Ω 617 Ni	DIN** 43760 Table
10Ω*** Cu	RO = 9.042 Ohms R25 = 10.005 Ohms ALPHA = 0.004260

See IPTS 68 equations in NBS Monograph 126. Type 1 no longer available.

***European Standard.*

****Contact factory for information on the 2180A/AT for 10Ω, 3 wire applications.*

2180A Accuracy (Type 2)* (Celsius)

RTDs		Maximum Error*		
		±Degrees C		
Type	Applicable Portion of Temperature Range °C	At Cal	90 Days 20°C to 30°C	1 Year 15°C to 35°C
100Ω	-190 to 0 0 to 204	0.043 0.043	0.089 0.132	0.112 0.173
385 Pt	-190 to 0 0 to 750	0.11 0.11	0.12 0.26	0.14 0.37
100Ω	-200 to 0 0 to 204	0.009 0.009	0.055 0.098	0.078 0.139
390 Pt	-200 to 0 0 to 750	0.08 0.08	0.10 0.23	0.11 0.32
100Ω	-200 to 0 0 to 204	0.040 0.040	0.086 0.13	0.109 0.171
3916 Pt	-200 to 0 0 to 750	0.11 0.10	0.12 0.26	0.14 0.34
100Ω	-200 to 0 0 to 204	0.008 0.009	0.055 0.098	0.078 0.139
392 Pt	-200 to 0 0 to 750	0.08 0.08	0.10 0.23	0.11 0.32
100Ω	-60 to 0 0 to 93	0.129 0.129	0.157 0.176	0.172 0.199
617 Ni	-60 to 0 0 to 177	0.19 0.19	0.20 0.22	0.21 0.25
10Ω Cu	-75 to 0 0 to 150	0.16 0.16	0.18 0.20	0.19 0.23
Ohms	0 to 196.99 0 to 999.99	0.005 0.05	0.042 0.22	0.059 0.31

2180A Accuracy (Type 2)* (Fahrenheit)

RTDs		Maximum Error*		
		±Degrees F		
Type	Applicable Portion of Temperature Range °F	At Cal	90 Days 20°F to 30°F	1 Year 15°F to 35°F
100Ω	-309.9 to 32 32 to 399.2	0.076 0.076	0.161 0.239	0.203 0.314
385 Pt	-309.9 to 32 32 to 1382.0	0.18 0.18	0.21 0.46	0.24 0.62
100Ω	-327.9 to 32 32 to 399.2	0.015 0.015	0.100 0.177	0.142 0.252
390 Pt	-327.9 to 32 32 to 1382.2	0.13 0.13	0.16 0.41	0.19 0.57
100Ω	-327.9 to 32 32 to399.2	0.071 0.071	0.156 0.234	0.198 0.309
3916 Pt	-327.9* to 32 32 to 1382.2	0.17 0.17	0.21 0.46	0.24 0.62
100Ω	-327.9 to 32 32 to 399.2	0.014 0.014	0.099 0.177	0.141 0.252
392 Pt	-327.9 to 32 32 to 1382.2	0.12 0.12	0.16 0.41	0.19 0.57
100Ω	-76 to 32 32 to 199.4	0.230 0.231	0.282 0.317	0.308 0.359
617 Ni	-76 to 32 32 to 350.6	0.33 0.33	0.39 0.39	0.35 0.44
10Ω Cu	-103 to 32 -103 to 302	0.27 0.27	0.31 0.35	0.34 0.41
Ohms	.005 .05	All units In Ohms		

Note: Shaded area is 0.01° resolution; unshaded area is 0.1° resolution.
**Total instrument accuracy. Does not include RTD probe errors. Valid for 4-wire RTDs only.*
Microcomputer Type 1 no longer available.

2189A Thermometry System

Includes Platinum RTD Probe Y2039 and a 2180A RTD Thermometer.

Maximum System error (±°C)

Temp. °C	At Calibration	90 Days 18°C-28°C Ambient	1 Year 18°C-28°C° Ambient

Low Temperature Range...

-183	(1)	(1)	(1)
-50	0.04	0.08	0.11
0	0.03	0.07	0.09
50	0.05	0.10	0.13
100	0.07	0.12	0.16
150	0.08	0.15	0.20
200	0.09	0.17	0.23

High Temperature Range...Periodic probe exposure*

204	0.14	0.25	0.27
300	0.18	0.32	0.33
400	0.21	0.39	0.40
480	0.29	0.48	0.50

(1) The system operates down to -183°C but the probe calibration is not verified below -50°C. It is estimated that the accuracy below -50°C is the same as the accuracy at an equal temperature in the positive range. Low temperature calibrations are available as a special.
**Accuracy above 200°C is based on the user performing an Ice Point adjustment in accordance with the following schedule:*

Probe Exposure Temperature Range	*Total Exposure Time Before Adjustment*
200°C t0 350°C	*500 hours*
350°C to 480°C	*250 hours*

Exposure of the Y2039 at high temperatures for long periods of time may cause the probe to change its characteristics and require the accuracy specifications to be degraded. For example, there is a 20% probability that exposure at 480°C for 500 hours will require degrading. It is easy for the user to determine if degrading is necessary by measuring the Ice Point resistance of the probe. The 2189A Instruction Manual explains this degrading procedure.

2190A Specifications

Thermocouple Types: Five, switch-selectable. Which thermocouple types depends on your choice of microcomputer type. See Accuracy chart below.

2190A Accuracy* (Celsius)

RTDs		Maximum Error* ±Degrees C		
Type	Applicable Portion of Temperature Range °C	At Cal	90 Days 20°C to 30°C	1 Year 15 C to 35°C
Type 1				
J	-128 to 0 0 to 900	0.18 0.18	0.19 0.31	0.21 0.36
K	-132 to 0 0 to 1350	0.18 0.18	0.19 0.39	0.21 0.47
T	-243 to 0 0 to 400	0.18 0.18	0.20 0.22	0.22 0.25
R	0 to 1708	0.31	0.59	0.70
C**	0 to 2471	0.18	0.60	0.75
Type 2				
J	-128 to 0 0 to 900	0.18 0.18	0.19 0.31	0.21 0.36
K	-132 to 0 0 to 1350	0.18 0.18	0.19 0.39	0.21 0.47
E	-252 to 0 0 to1000	0.18 0.18	0.20 0.33	0.22 0.39
R	0 to 1708	0.31	0.59	0.70
S	0 to 1685	0.22	0.50	0.60
Type 3				
J DIN**	-100 to 0 0 to 760	0.18 0.18	0.19 0.28	0.20 0.33
K	-50 to 0 0 to 1372	0.18 0.18	0.18 0.39	0.20 0.48
T DIN**	-200 to 0 0 to 400	0.18 0.18	0.20 0.22	0.21 0.25
B	420 to 1815	0.21	0.52	0.62
R	140 to 1700	0.18	0.46	0.46

2190A Accuracy* (Fahrenheit)

RTDs		Maximum Error* ±Degrees F		
Type	Applicable Portion of Temperature Range °F	At Cal	90 Days 20°F to 30°F	1 Year 15°F to 35°F
Type 1				
J	-198 to 32 32 to 1652	0.20 0.20	0.23 0.47	0.26 0.58
K	-206 to 32 32 to 2462	0.30 0.30	0.33 0.72	0.37 0.87
T	-405 to 32 32 to 752	0.30 0.30	0.35 0.41	0.39 0.46
R	32 to 3106	0.47	1.01	1.20
C**	32 to 4480	0.30	1.11	1.37
Type 2				
J	-198 to 32 32 to 1652	0.20 0.20	0.23 0.47	0.26 0.58
K	-206 to 32 32 to 2462	0.30 0.30	0.33 0.72	0.37 0.87
E	-422 to 32 32 to 1832	0.30 0.30	0.33 0.61	0.40 0.72
R	32 to 3106	0.47	1.01	1.20
S	32 to 3065	0.38	0.92	1.10
Type 3				
J DIN**	-148 to 32 32 to 1400	0.30 0.30	0.32 0.52	0.36 0.61
K	-58 to 32 32 to 2502	0.20 0.20	0.22 0.63	0.25 0.78
T DIN**	-328 to 32 32 to 752	0.30 0.30	0.34 0.41	0.38 0.46
B	788 to 3299	0.37	0.95	1.15
R	284 to 3092	0.20	0.74	0.93

* *Total instrument accuracy. Does not include Thermocouple errors*
** *C designates Tungsten-5% Rhenium vs. Tungsten 26% Rhenium*
*** *DIN 43710, a European Standard until 1984*

Resolution: 0.1°C, °F
Input Connection: 2 wires on screw terminal isothermal block
Max Source Impedance: 2 kΩ
Overrange Detection: Flashing display
Open Circuit Detection: Source impedance of 3 kΩ or more causes of flashing "0C"
Repertoire: SH1, AH1, T6, LO, SR1, RLO, PPO, DC0, DT0, C0, E2
Service Request Usable: Yes
Power: Operates only when powered by AC line

2190A/AM Thermocouple Thermometer

The 2190A/AM is a modified 2190A thermometer with fifteen thermocouple linearizations instead of the standard five. The user can select any of the 15 thermocouple types by adjusting the configuration of a multiswitch. The Model 2190A/AM provides all of the benefits of the standard 2190A in accuracy and system capability. The 2190A/AMK is a kit for retrofitting existing 2190As. The 2190A/AM offers the Japanese (JIS) series and European (DIN) of linearizations as well as the U.S. N and D linearizations.

Specifications are equivalent to those of the standard 2190A. Thermocouple Types Supported: NBS types (J,K,T,C,R,E,S,B,N,D), DIN types (J,T), JIS Types (J,K,R)

Option Specifications

Output Option (-002)

Analog Output
Type: Linearized and isolated
Voltage: 1.0 mV/°C or °F to 5 mA max
Temperature Coefficient: 200 ppm/°C from 25°C
Noise: ≤100µV at 100 Hz bandwidth
Accuracy: ±0.1% of reading ±1mV
Drift: 200µV/°C from 25°C
Overload or Open Circuit: Zero volts via banana jacks

Digital Output
Types: Four, E.I.A. Standard RS-232-C, TTY current loop, parallel ASCII, and Fluke PTI
Connector: 36-pin AMP "Champ"
Serial Baud Rates: 110, 150, 300, 600, 1200, 2400, 4800, or 9600, switch-selectable
RS-232-C Signals: Transmitted Data, Request to Send, Clear to Send, Data Set Ready, Signal Common
Parallel ASCII Signals: Data: 8 lines; Instrument Address: 4 lines; Address Valid; Data Valid; Acknowledge: Ground; +5V
TTY Current Loop Signals: Source and controlled sink, 20 mA
Out-of Limit Signals: Exclamation point transmitted with Option -006 only

Limits Option (-006)

Limits Function: Lights LED and activates form A (SPST) reed relay when thumbwheel setpoint is exceeded. Reed relay rated 10 VA, 184V dc or 130V ac rms max, 0.5A max, resistive, Selectable either low (≤) or high (≥)
Min/Max Function: Continuously stores Min and Max temperature
Delta Function: Displays difference between thumbwheel setpoint and actual temperature
Thumbwheels: 6, for function, sign, and setpoint (±9999). Setpoint resolution is 1 degree.

Accessory Specifications

Y2000 RTD Multipoint Selector

Channels: Ten per Y2000, up to ten Y2000s per 2180A. Channel number sent to printer or computer when Output Option -002 or -004 are used
RTD Types: Same as 2180A. Two types per Y2000
Power: Supplied by 2180A
Interfacing: Attached 46-cm cable plugs into rear of 2180A or Y2002. Receptacle accepts cable chained from other Y2000s
Size and Weight: Style A PTI case, 1.4 kg (3.09 lb)

Y2001 Thermocouple Multipoint Selector

Channels: Ten per Y2001, up to ten Y2001s per 2190A. Channel number sent to printer or computer when OUtput Option -002 or -004 are used
Thermocouple Types: Same as 2190A. Two types per Y2001
Maximum Voltage Between Channels: 125V ac rms
Power: Supplied by 2190A
Interfacing: Attached 46-cm cable plugs into rear of 2190A or Y2002. Receptacle accepts cable chained from other Y2001s
Size and Weight: Style A PTI case, 1.6 kg (3.53 lb)

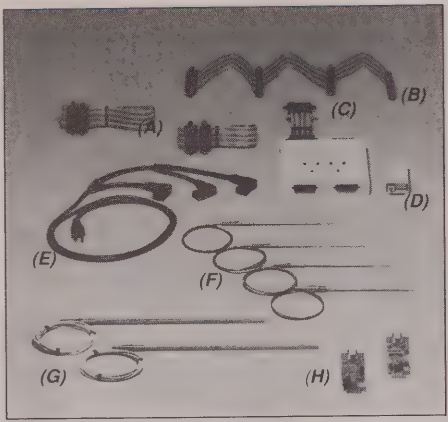
Y2003 Thermocouple Calibrator and Battery Pack

Thermocouple Types: Same as 2190A
Output Voltage: -10 mV to +90 mV, adjustable. Applied at input terminals of 2190A and thermocouple thermometer of less accuracy to be calibrated
Adjustments: Coarse, fine and offset
Battery Pack: Same specifications as Y2009
Interfacing: Attached 46-cm cable plugs into rear of 2190A
Size and Weight: Style B PTI case, 2.6 kg (5.74lb)

Y2009 Rechargeable Battery Pack

Output: 12V dc, 750 mA max
Battery: Ten 1/2-D size cells in drip-proof case
Operating Time: 5-6 hours typical at 25°C on full charge when connected to 2180A, 2190A
Recharge Time: 16 hours typical at 25°C
Charger: Built-in-on-off-switch, low-battery automatic discharge cut-off
Output Connectors: Rear panel screw terminal block
Operating and Storage Temperature: 0°C to 40°C
Power: 100, 120, 220, or 240V ac±10% selectable, 50 to 400 Hz; 10W, typical
Size and Weight: Style B PTI case, 2.5 kg (5.52 lb), typical

A Family of Accessories



Small accessories shown are: ***(A)*** *Y7203 and Y7204 PTI Polling Cables,* ***(B)*** *Y2036 3-Module PTI Polling Cable,* ***(C)*** *Y2026 Cable/Adapter,* ***(D)*** *Y2022 Calibration Divider,* ***(E)*** *Y2024 3-Module Power Cord,* ***(F)*** *P20-Series Thermocouple Probes,* ***(G)*** *Y2037 and Y2039 RTD Probes,* ***(H)*** *Y2030 and Y2031 Plug-In Modules.*

Y2022 Thermometer Calibration Divider (D in Picture)

Function: Either precision resistor or voltage divider (÷10 or ÷100)
Input Voltage: 0-10V dc
Output Impedence: 100Ω
Precision Resistor: 100Ω±0.01Ω, temp coefficient 5 ppm

Y2024 3-Module Power Cord (E in Picture)

Connects three PTI-family instruments or accessories to single 120V ac power outlet

Y2026B RS-232-C Cable Adapter (C in Picture)

Function: Routes RS-232-C signals from 36-pin PTI connectors to 25-pin RS-232-C connectors
Connections: Two 36-pin PTI connectors (M and F), two 25-pin RS-232-C connectors (M and F). Y7203 cable supplied
RS-232-C Pin Selections: Slide switches. Select TD on pin 2 or 3; DTR, DSR and CTS, through or pulled up; Scanner busy, through or to CTS

Y2030 Plug-in Module (H in Picture)

Extra plug-in units for 2190A thermocouples. Leave attached to input wire-pair for easy interchange of thermocouple inputs.

Y2031 Plug-in-Module (H in Picture)

Extra plug-in unit for 2180A RTDs, leave attached to input wires for easy interchange of RTD inputs.

Y2036 PTI Polling Cable (B in Picture)

Connects up to three PTI-family measurement instruments to 2020A or 2030A Printer.

Y2037 Platinum RTD Probe (G in Picture)

Resistance: 100Ω ± 0.1Ω at 0°C
Temperature Range: -80°C to +480°C
Curve Conformity: ±0.1% of temperature using IPTS 68 with ALPHA = 0.0038994 and DELTA = 1.494
Stability: Periodic usage (20% of time) ±0.03°C if used from 0°C to 200°C and ±0.22°C if used from -80°C to +480°C
Hysteresis: Less than ± 0.08°C when using 0°C and 200°C as end points
Immersion Effects: ±0.005°C when going from 4 inches to 10 inches in an ice bath Transition End Temperature: 150°C maximum
Physical: 316 SS Sheath, 0.25 in diameter x 12 in L; four 6 ft leads #22 AWG stripped and tinned
Handling: Contains strain-free platinum coil. Must be handled with care.

Y2039 Platinum RTD Probe (G in Picture)

Probe resistance: 100Ω ± 0.1Ω at 0°C
Temperature Range: -183°C to +480°C
Performance Standard: R100° /RO° = 1.3922, nominal. Conforms to IPTS 68 within 0.03% of temperature from -50°C to 420°C using ALPHA = 0.0039221 and DELTA = 1.493
Resistance Stability: 12 mΩ/year when exposed at 200°C or 20 mΩ in 250 hours when exposed at 480°C measured with probe at 0°C. 4 mΩ = 0.01°C + 0.04% of temperature
Hysteresis: Less than 0.01°C at 200°C when using 0°C and 420°C as end points
Immersion Effects: The readings shall not vary more than 0.005°C when probe is varied from 4 to 10 inches in an ice bath
Transition End Temperature: 150°C maximum
Time Constant: 8 seconds maximum when tested in flowing water at 3 feet per second
Sheath Material: INCONEL
Size: Diameter 0.64cm (0.25 in), length 30.5 cm (12 in)
Leads: 4 wires, 6 ft, #22 AWG, ends stripped and tinned
Calibration: Each probe is calibrated at 0°C, 200°C and 420°C. The IPTS 68 constants R0, ALPHA, DELTA and A4 are provided
Handling: Contains strain-free platinum coil. Must be handled with care

PTI Case Dimensions

Style	Height	Width	Depth
A	5.7 cm (2.25 in)	20.5 cm (8.05 in)	32.6 cm (12.85 in)
B	8.2 cm (3.23 in)		
C	10.5 cm (4.13 in)		
D	12.8 cm (5.03 in)		

General Specifications

Display: °F or °C, switch-selectable; 7 segment 1.1 cm LED
Measurement Method: Dual-slope integration, 100ms integration time, 3.33 readings/second
Linearization Technique: Segmented 4th order curve fit
Temperature Coefficient: ±15ppm/°C from 25°C
Stability: 175 ppm/90 days, 200 ppm/year
Common Mode Voltage: 350V dc, 250V rms ac, max
Common Mode Noise Rejection: ≥160dB at 50, 60, and 400 Hz ± 0.1% 100Ω unbalance
Normal Mode Noise Rejection: ≥90dB at 50, 60 and 400 Hz ± 0.1%
Drift: None, automatic zero correction
Input Impedence: 1000 MΩ at dc
Accessory Connector: 25-pin rear panel receptacle interfaces thermometer to Y2000, Y2001, Y2003, and 2300A
Shock and Vibration: Meets MIL-T-28800C, class 3 specifications
Ambient Temperature: 0°C to 50°C operating, -40°C to 75°C non-operating
Relative Humidity: ≤80% from 0°C to 50°C non-condensing
Power: 12V dc or 100, 120, 220, 240V ac ± 10% selectable, 50 to 400 Hz; 8W typical
Size: Style C PTI case, 10.5 cm H x 20.5 cm W x 32.6 cm D (4.13 in H x 8.05 in W x 12.85 in D)
Weight: 2.1 kg (4.63 lb)
Safety: (2180A and 2190A only) Factory Mutual 3820 approved, CSA 556B certified
Included: Instruction manual, power cord. Probes are not included except with 2189A

Ordering Information

Models

January 1989 prices

RTD Thermometers

2180*	$1135
2189A System	1850

** Contact factory for 3-wire 10Ω copper applications*

Thermocouple Thermometers

2190A Type 1 — J,K,T,R,C	1085
2190A Type 2 — J,K,E,R,S	1085
2190A Type 3 — J(DIN), K,T (DIN),B,R	1085
2190A/AM (15 types)	on req
2190A/AMK (15 types) Upgrade Kit for 2190A	on req

Also see page 452, 2383A and 2393A Temperature Logging Systems

Options (for 2180A, 2189A, 2190A)

-002* Analog and Digital Output	395
-004** IEEE-488 Output	450
-006 Limits	265

Note: Above options are customer installable
**Required for compatibility with 2020A-004 or 2030 Printer or 1120A Translator. However, the option is not required when the thermometer is used with a 2300A Scanner, unless analog output is also needed.*
***Cannot be used with Option -002*

Accessories (Also see page 485)

Used for 2190A

P20J* Thermocouple Probe	63
P20K* Thermocouple Probe	63
P20T* Thermocouple Probe	63
P20E* Thermocouple Probe	63
Y2001 Multipoint Selector for Thermocouples	635
Y2003 Thermocouple Calibrator/ Battery Pack	685
Y2022 Thermometer Calibration Divider	130
Y2030 Thermocouple Input Module	95

Used for 2180A & 2189A

Y2000 Multipoint Selector for RTDs	$635
Y2031 RTD Input Module	95
Y2037 RTD Probe 100Ω 390PT	260
Y2039 RTD Probe 100Ω 392PT	700

Joint Accessories

Y2009 Battery Pack, Rechargeable	440
Y2014** 5-1/4" Rack Mount Kit PTI, Single, Size C, Offset	95
Y2015** 5-1/4" Rack Mount Kit PTI, Double, Size C	95
Y2020** 4.80 DIN Panel Mount Kit PTI	95
Y2026B RS-232- Cable Adapter	180
Y2024 3-Module Power Cord	21
Y2036 PTI Polling Cable	83
Y7203 2-ft 36-pin PTI Cable	55
Y7204 5-ft 36-pin PTI Cable	70

**See page 442 for specifications*
***See page 485 for other size PTI rack mount kits and panel mount kits*

Also see 2030A Printer/Plotter, page 456; 2300A Scanner, page 450 and IEEE-488 Translator, page 361.

Service and Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2180A Repair (w/ calibration)	126
SC1-2180A Repair (cal w/ in or out data)	161
SC1-2180A Repair (cal w/in and out data)	196
SC2-2180A Cal (1/yr recommended)	63
SC2-2180A Cal (1/yr w/in or out data)	98
SC2-2180A Cal (1/yr w/in and out data)	133
SC1-2189A Repair (w/ calibration)	134
SC1-2189A Repair (cal w/ in or out data)	169
SC1-2189A Repair (cal w/in and out data)	204
SC2-2189A Cal (1/yr recommended)	72
SC2-2189A Cal (1/yr w/in or out data)	107
SC2-2189A Cal (1/yr w/in and out data)	142
SC1-2190A Repair (w/ calibration)	110
SC1-2190A Repair (cal w/ in or out data)	145
SC1-2190A Repair (cal w/in and out data)	180
SC2-2190A Cal (1/yr recommended)	63
SC2-2190A Cal (1/yr w/in or out data)	98
SC2-2190A Cal (1/yr w/in and out data)	133

2300A (TemPak Series)

GPIB
IEEE-488

RS-232

2300A

2300A Temperature Scanner

- Can be used with either thermocouples or RTDs
- Capable of scanning 20 points
- Expandable to 100 points with the 2301A Extender Chassis
- Scanning can be either manually or automatically with a set interval time
- Unused channels can be skipped through a switch setting
- Two interface options. One provides remote programming capabilities
- LED display specifies the channel being monitored
- Two different types of thermocouples or RTDs can be used per input card
- Capable of running off of 12V dc or ac line power

The 2300A Temperature Scanner is designed to be used with either a Fluke 2180A or 2190A Digital Thermometer to sequentially scan and read the temperature of up to 20 RTDs or thermocouples. For even more capacity, a 2301A Scanner Extender can be added to scan an additional 30 sensors. Two 2301s may be stacked and latched together to scan up to 80 channels and a third may be added to scan up to 100 channels.

Scanning may be done one channel at a time manually, with keystrokes at the front panel, or automatically. Readings also may be printed at pre-selected intervals using either a Fluke 2030A Computing Printer or a 2020A Universal Interface Printer with the relevant options. All of these instruments are packaged in Fluke stack-and-latch cases that quickly and easily fit together to become an integrated, multichannel, temperature scanning and logging system. Using a 12V battery, a system may be operated in the field, away from any ac power source.

For preconfigured Temperature Logging System, see the 2382A and 2393A.

For applications that need mixtures of thermocouples, RTDs, dc voltages, 4 to 20 mA control loops, or contact closures, etc., see the 2280 Series Data Loggers on page 399.

Scanner Card Options (-002 & -003)

Both the -002 Thermocouple Scanner Card option and the -003 RTD Scanner Card Option provide for 10 sensor inputs. The inputs are divided into two blocks of five, so two different thermocouple types (or two different RTD types) may be used with each card. A switch allows you to automatically skip any unused channels, or you may skip them from the front panel of the Scanner.

Up to two cards (20 channels) may be housed in a 2300A Scanner, and up to three cards (30 channels) in a 2301A Scanner Extender. At least one scanner card is required for the 2300A to operate. Thermocouples and RTDs may not both be scanned at the same time by one 2300A.

Interface Card Option (-006)

This option will interface to either a 2180A or 2190A, and provide RS-232-C output for communication to external printers or computers. Option -006 allows remote control of the Scanner via either a bi-directional RS-232-C link or via the GPIB/IEEE-488* bus (with the 1120A Translator). No interface option is required for a 2301A Scanner Extender.

The Y2026B RS-232-C Cable Adapter is available to connect the 36-pin connector on the back of the Scanner to a cable with a standard 25-pin connector. Or you can wire your own cable to the connector provided.

Specifications

Technical Specifications

Channel Capacity: 10 or 20 channels in a 2300A; 10, 20, or 30 channels in each 2301A Extender Chassis; 100 channels per system, maximum. Each system to scan only RTDs (2180A) or only thermocouples (2190A)

Front Panel Programming: Automatic or Manual Scanning, Channel Skips, Channel Delay Time, Fast Forward, Fast Reverse

Display: Two digits, 00 through 99; either channel number or channel delay time

Channel Delay Time: Time interval between scanner relay contact closure and scanner trigger signal that initiates measurement instrument reading. Programmable from 0.0 to 8.0 seconds, 2 seconds or greater required for rated accuracy

Printer Control of Scan Interval: Either the 2020A Printer (with Option -004 and -006) or the 2030A Printer can be programmed to control the time between each scan cycle when connected to the 2300A

Scan Speed: Dependent on measurement instrument and application

Required Options: One Interface Option (-006) and at least one Scanner Card Option (-002 or -003). Also, one to three scanner card options per 2301A Extender Chassis if the 2300A is needed.

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* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

IEEE-488 System: Requires 1120A Translator with Option 2XXXA-522 installed and Y7203 PTI cable:
RS-232-C Compatibility: Y2026B Cable/Adapter recommended

Option Specifications

Thermocouple Scanner Card Option (-002)

Input Channels: 10
Input Connections: Two wires per channel on screw terminal isothermal block
Thermal Offset Error: 1 microvolt, max
Channel Switches: 2-pole reed relays
Max Input Voltage: 170V dc or peak ac
Max Common Mode Voltage: 350V dc or peak ac between any two channels or between the cahssis and a channel
Thermocouple Types: See 2190A Thermometer Specifications
Switch-selectable Types: Two; five channels per thermocouple type
Reference Junction Compensation: Temperature-sense transistor on scan card isothermal block is used to send isothermal block temperature to 2190A for automatic ice point compensation

RTD Scanner Card Option (-003)

Input Channels: 10
Input Connections: 4-wire screw terminal
Thermal Offset Error: 10 microvolts max
Channel Switches: 3-pole reed relays
Max Input Voltage: 30V dc or peak ac
RTD Types: See 2180A Specifications
RTD Types Selectable: Two; five channels per RTD type

Interface & Remote Control Option (-006)

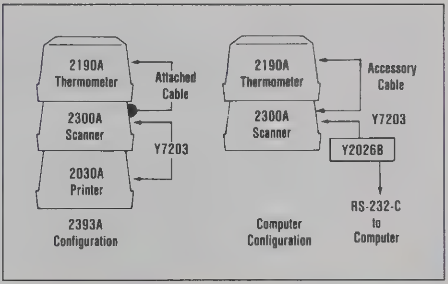
Option -006 provides the capability to be remotely programmed via the 1120A IEEE-488 Translator or RS-232-C terminal
I/O Connections: Interface Option -006 includes an attached accessory cable with a 25-pin male connector that plugs into the back of a 2180A or 2190A Digital Thermometer. The Option also provides a rear panel 36-pin connector for outputs to printers and computers.
36-Pin Connector: the Portable Test Instrument (PTI) connector is used to transfer information from a 2300A Scanner and 2180A or 2109A Thermometer to a printer, RS-232-C device, or IEEE-488 bus via the Fluke 1120A translator. The output information is: Channel number, temperature value, termperature scale (°C or °F), open circuit symbol, overrange symbol, limit-exceeded symbol (if 2180A or 2190A has Option -006), carriage return (CR), and line feed (LF). AY7203 Accessory cable is required for connecting a printer or 1120A Translator. AY2026B Cable/Adapter is strongly recommended for transmitting RS-232-C signals.
Signals: RS-232-C Transmitted Data, Request to Send, Clear to Send, Data Set Ready, Data Terminal Ready, Received Data, Received Line Signal Detector, Scanner Busy Ground, Source and Controlled Sink of 20 mA for TTY current loop operation (not used for programming commands). Baud rates are 110, 150, 300, 600. 1200, 2400, 4800, or 9600, switch-selectable.
IEE-488 Signals: All IEEE Std 488-1978 signals when used with 1120A Translator with Option 2XXXA-522 installed. Interface functions SH1, AH1, T6, L4, SR1 can be implemented.
Remote Programming: The 2300A accepts commands for programming channel delay time, channel skips, monitor channel, first and last channel single scans, and first and last channel continuous scanning. Programming is activated by sending command character codes on data line of IEEE-488 bus via the 1120A Translator or on the Received Data line via an RS-232-C device

Command Characters & Meanings

ESC	Toggle Interface Direction
R	Place Scanner in Remote Control
L	Place scanner in Local Control
D mm	Set channel delay time to m.m seconds
S mm-nn	Skip channels mm to nn
U mm-nn	Unskip channels mm to nn
M mm	Monitor channel mm
A mm-nn	Continuously scan from channel mm to nn
X mm-nn	Make a single scan from channel mm to nn
RP	Print Scan Mode
MP	Print current channel
AP	Print first and last channels
XP	Print first and last channels
DP	Print channel delay

General Specifications

Ambient Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤75% to 50°C, operating; -20°C to +70°C, non-operating
Safety: IEC 348 Protection Class I, solely as it relates to insulation or grounding properties
Power
2300A: 100 to 130V ac or 200 to 260V ac, switch-selectable, 50 to 60 Hz, or 12V dc, 8 Watts
2301A: Supplied by the 2300A Scanner mainframe
Size: Style D PTI case, 13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in x 8.05 in x 12.85 in) both 2300A and 2301A
Weight
2300A: Approximately 3.6 kg (8 lb) depending on the options
2301A: Approximately 2.7 kg (6 lb) depending on the scanner cards installed
Included
2300A: Instruction manual, power cord, attached cable for 2180A or 2190A
2301A: Instruction manual, attached cable for 2300A or another 2301A



Ordering Information

Models

January 1989 prices

2300A Scanner	$700
2301A Extender Chassis	440

Interfacing a 2300A Scanner/2180A/2190A Thermometer combination to the IEEE-488 Bus requires a Y7203 or Y7204 Cable, the 1120A Translator and the 2XXXA-522 Personality Card. The 21X0A-002 or 21X0A-004 thermometer options are not required.

Options (for 2300A and 2301A)

-002 Thermocouple Scanner Card	435
-003 RTD Scanner Card	435
-006*Interface, Output and Remote Control	650

**Includes attached ribbon cable for 2180A or 2190A. For factory or Service Center installation only.*

Accessories

1120A IEEE-488 Translator	590
2XXXA-522* Personality Card for 1120A	405
Y2016 7" Rack Mount Kit PTI, Single	95
Y2017 7" Rack Mount Kit PTI, Double	95
Y2021 5.7" DIN Panel Mount Kit PTI	95
Y7203 36-Pin PTI Cable, 2ft	55
Y7204 36-Pin PTI Cable, 5ft	70
Y2026B RS-232-C Cable Adapter	180

**Required with 1120A Translator for IEEE-488 compatibility. Y7203 or Y7204 Cable also required.*

Service and Support

Warranty
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

SC1-2300A Repair (w/calibration)	130
SC1-2300A Repair (cal w/in or out data)	145
SC1-2300A Repair (cal w/in & out data)	160
SC2-2300A Cal (1/yr recommended)	31
SC2-2300A Cal (1/yr w/in our out data)	46
SC2-2300A Cal (1/yr w/in & out data)	61

2383A/2393A (TemPak Series)

2393 Temperature Logging System

2383A & 2393A Temperature Logging System

- Completely configured and tested temperature logging systems
- Capable of running off of 12V dc
- Capable of scanning 20 points, and expandable to 100 points with the 2301A Extender Chassis
- Scan either manually or automatically with a set interval time
- The 2300A Printer with your choice of either RTD or thermocouple capability
- Six different RTD types are switch-selectable. Four platinum, one nickel, one copper, (2383A only)
- Ten different thermocouple linearizations are supported including two DIN standards, (2393A only)

Two portable, factory-integrated and tested temperature logging systems are available. They offer a choice of thermocouple or RTD measurements and a 2030A Printer. Temperature information from up to 10 sources may be logged using either of the two systems, or up to 20 by ordering one additional scanner option (-003 for RTDs or -002 for thermocouples). And each system may be expanded to monitor up to 100 points. Although the component parts may be ordered separately and assembled by the user, choosing the right combination of instruments, options, cables, etc., for your application is simplified by purchasing one of the systems. There is even a modest price advantage in purchasing a factory-tested system. Each offers the most accurate temperature logging capability that Fluke manufactures.

For applications that need mixtures of thermocouples, RTDs, dc voltages, 4 to 20 mA control loops, or contact closures, etc., see the 2280B Series Data Loggers on page 399.

The following chart shows the component parts of the two systems.

System Components

Items Included	RTDs	Thermocouples	See Page
	2383A	2393A	
2180A Thermometer	1	-	444
2190A Thermometer	-	1	444
2300A Scanner	1	1	450
Option -006	1	1	451
Option -003*	1	-	451
Option -002*	-	1	451
2030A Printer	1	1	455
Y7203 Cable	1	1	448
Y2024 Power Cord	1	1	448

**Ten channels per option. One additional option may be installed in the 2300A. Up to 3 additional options may be plugged into each additional 2301A Scanner Extender. Maximum number of channels is 100.*

Specifications

Please refer to the pages listed above for the specifications and performance characteristics of the instruments and options comprising each system.

Ordering Information

Models

2383A RTD Systems w/2030A Printer
2393A T/C System w/2030A Printer

Note: When ordering 2393A state whether for Type 1, 2, or 3 thermocouple linearizations. See page 447.

Note: When using the limits function it should be applied at a single channel.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

2020A (TemPak Series)

GPIB IEEE-488

RS-232

2020A with Option -006

2020A Universal Printer

- 20-column thermal printer for recording data from a variety of instruments
- 3 interface options are available: RS-232-C, GPIB/IEEE-488, or Fluke PTI Polling
- Designed to be integrated with a wide variety of Fluke instruments and accessories through an integral latching system
- Time interval print capability with the -006 option
- Capable of running off of 12V dc or ac line power
- Single or continuous print cycles can be triggered either from the front panel or using the remote trigger connector on the rear of the instrument
- Graphic plotting available when using the -003 interface (IEEE-488)

Both the 2020A and 2030A Printers have 20-column thermal print heads for recording measurement data from a variety of Fluke instruments. Especially recommended are those instruments packaged in Fluke's Portable Test Instrument (PTI) cases. They will stack and latch to a 2020A or 2030A Printer and to one another. Connecting cables attach to the rear panels.

Because the 2300A Scanner is designed to let you measure the temperature of numerous points with just one Fluke 2180A or 2190A Thermometer, the 2020A and 2030A Printers are particularly recommended for temperature scanning and logging. Thermometer, scanner, and printer are stacked and latched together and used as an integrated temperature measuring system.

2020A Universal Printer

The Fluke 2020A is a 20 column thermal printer with three interchangeable data interface options. Whether you need GPIB/IEEE-488*, RS-232-C, or Fluke's own Portable Test Instrument (PTI) polling interface, the 2020A has the option to match. The 2020A operates from either the ac power line or a nominal 12-volt dc source.

Graphic Printing

The 2020A with and IEEE-488 interface is capable of printing a dotted graph of incoming data. The data source must send the correct 8-bit binary code for trace-on, 0-99 for the dot location, line feed, and finally trace-off. Use this feature to plot trends and trace profiles in addition to normal print out.

PTI Polling

The 2020A's PTI polling interface contains a microcomputer with addressing intelligence designed to generate the assigned addresses of several instruments in the PTI family. Select a print mode and the 2020A automatically begins polling by sequentially sending addresses one through nine until a measurement instrument recognizes its address. The 2020A then prints both the address and the instrument's current reading. A typical polling system might include the 2020A with a 2190A Thermometer and a 8920A Voltmeter.

Time Interval Printing

Fluke offers the 2020A with time interval printing (Option -006). It allows printing at preselected time intervals from ten seconds up to eight hours. When you use the time interval print option and a PTI polling interface, the 2020A will automatically label the printer tape with elapsed time each time it prints a set of readings.

Your choice of three field-installable interface circuit cards.

Option-002	Option-003	Option-004
RS-232-C	GPIB IEEE-488	Parallel ASCII and PTI Polling
25-Pin Female	24-Pin Female	36-Pin male
Y1707 or Y1708	Y8021 Y8022 or Y8023 Cable	Y7203 Y7204 or Y2036 Cable
	Inst. & Opt. 1722A 1752A 1953A-15 2200B-37 2240C-15 8500A-05 8502A-05 8505A-05 8506A-05 8520A 8840A-05 8842A-05 8860A-05	Inst. & Opt. 2180A-002 2190A-002 2300A-005 2300A-006 7220A-521 7250A-521 7260A-521 7261A-521 8600A-521 8810A-521 8920A-521 8921A-521 8922A-521

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

2020A (TemPak Series)

Specifications

Option Specifications

RS-232-C Interface (-002)

Input Connector: Standard 25-pin, female
Signals: Transmitted Data, Clear to Send, Data Set Ready, Signal Ground, Received Line Signal Detector
Baud Rates: Switch-selectable for 110, 150, 300, 600, or 1200
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,s,μ,z
Buffer Storage: 32 characters

IEEE-488 Interface (-003)

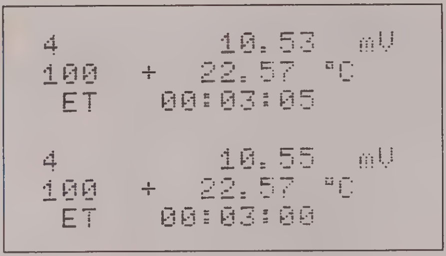
Input Connector: Standard 24-pin, female
Signals: Per IEEE Std 488-1978
Modes: Listen only or Addressable Listen, Switch-selectable
Repertoire: AH1,L1
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,μ,z
Graphic Printing: Dotted trace activated by receipt of the following binary-coded decimal numbers on incoming data lines: in-trace—16, dot location — 0 through 99, line feed—254, out-trace—255.
Buffer Storage: 1 line of data

PTI Polling Interface (-004)

Multi-Instrument Scanning: Up to nine Fluke measurement instruments with each having an internal preset address as follows: Adr 1 — 2180A, 2190A, 2300A; Adr 2—7250A, 7260A, 7261A; Adr3—7220
Input Connector: 36-pin AMP CHAMP, male
Signals: Data, 8 lines, Address, 4 lines; Address Valid; Data Valid; Data Acknowledge; Scan in Progress
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,s,μ,z
Buffer storage: 1 line of data

Time Interval Print (-006)

Print Intervals: Choice of 10, 20, 40, or 80 seconds, 1, 2, 4, 8, 10, 20, 40, or 80 minutes, or 1, 2, 4 or 8 hours
Time Annotation: Elapsed time printed with each reading (if Option -004 also installed)
Clock: Internal, crystal-controlled



```
4           10.53   mV
100   +   22.57  °C
 ET     00:03:05

4           10.55   mV
100   +   22.57  °C
 ET     00:03:00
```

Sample section of printed tape showing two readings 5 seconds apart. Reading from bottom to top: Elapsed time (ET) is 00 hours, 03 minutes, and 00 seconds. Address 1 Channel 00 is for the thermometer and address 4 is for the voltmeter.

General Specifications

Type: Thermal, 20-column
Characters: 5 x 7 dot matrix
Print Rate: 3 lines per second maximum
Spacing: 6 lines per inch (2.4 per cm)
Paper: 2.5 in (6.3 cm) wide, 240-ft roll (74m)
Advance: Stepping motor, belt drive
Remote Operation: Rear input, by external contact closure, TTL/DTL compatible
Safety: IEC 348, Protection Class 1
Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤95% to 25°C; ≤75% to 40°C; ≤45% to 50°C
Power: 11 to 15V dc, 90 to 132V ac, or 180 to 250Vac, switch-selectable, 47 to 440 Hz, 40W maximum
Size: Style D PTI Case—13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in x 8.05 in x 12.85 in)
Weight: Approximately 9 lb with paper
Included: Instruction manual, power cord, one roll of paper

Ordering Information

Model

January 1989 prices

2020A Printer	$895

Each printer requires one interface option and can only use one at a time.

Options (for 2020A)

-002	RS-232-C Interface	360
-003	Interface for IEEE-488	345
-004*	PTI Polling Interface	360
-006	Time Interval Print	235

All options field-installable. Cables not included.
**Accepts Y7203 or Y7204*

Accessories (Also see page 485)

Y2016	7" Rack Mount Kit PTI Single	$95
Y2017	7" Rack Mount Kit PTI Double	95
Y2021	5.70: DIN Panel Mount Kit PTI	95
Y2026B	RS232-C Cable Adapter	180
Y2035	Thermal Paper, 10 rolls	68
Y2036*	PTI Polling Cable	83
Y7203	2-ft Cable, 36-Pin, PTI	55
Y7204	5-ft Cable, 36-Pin, PTI	70
Y8021	1m Cable for IEEE-488 bus	130
Y8022	2m Cable for IEEE-488 bus	145
Y8023	4m Cable for IEEE-488 bus	155

**Uses when 2 or 3 PTI instruments are to be simultaneously connected to 2020A via Option -004. Use two cables for 4 or 5 instruments.*

Service & Support

Warranty

One-year product warranty. See page 470 for further information on warranty terms and conditions.

Comparison of 2020A and 2030A Printers

Features	2020A	2030A
Printers		
Measured data	Yes	Yes
Computed data	No	Yes
Data source identification	Yes	Yes
Real time	No	Yes
Elapsed time	Opt-006	Yes
Engineering units	No	Yes
Header	No	Yes
Strip chart graph	*	Yes
Print Cycle		
Front panel trigger	Yes	Yes
Remote trigger	Yes	Yes
Front panel continuous	Yes	Yes
Remote continuous	Yes	Yes
Pre-selected intervals	Opt-006	Yes
When limits crossed	No	Yes
Intervals and crossings	No	Yes
Computed Data		
mx+b scaling	No	Yes
± difference (delta)	No	Yes
±% (% delta)	No	Yes
Interfaces		
Fluke PTI	Opt-004	Yes
RS-232-C	Opt-002	No
IEEE-488	Opt-003	No

**Using Option -003 and 1722A Instruments Controller or similar computer.*

2030A (TemPak Series)

2030A

2030A Computing Printer

- 20-column thermal printer for recording data from a variety of instruments
- Multi-instruments scanning (up to 9)
- Time annotation - real, elapsed, interval
- Engineering units annotation - up to 4 alphanumeric characters
- Seven print modes
- Runs off 12V dc or ac line power
- Trace mode allows for plotting of data
- Designed to be integrated with a wide variety of instruments and accessories through an integral latching system
- Math mode allows you to program delta, %delta, and mx+b scaling
- Checks for both high and low alarms

The 2030A is a 20-column thermal printer with computing power. It combines standard printing-performance with a multitude of other special features. It is capable of mathematically scaling data and automatically documenting the printed results. It can translate numeric data into a visual trace, and it can apply limits and activate alarms. The 2030A prints data in any one of seven modes—from a single reading to programmed printing at periodic intervals.

Seven Print Modes

Trace: Data graphically plotted between programmable limits
Interval Trace: Graphic trace of data plotted at programmed time intervals
Interval: Prints at programmed intervals
Interval Limit: Prints at programmed intervals and monitors for alarms when not printing
Single: Prints one reading when pushbutton is pushed
Continuous: Continuously prints up to three readings per second
Remote: Prints continuously when activated (via rear panel)

Time Interval Printing

Inside the 2030A is a precision crystal measuring time and allowing you to control when data is scanned and /or printed. A 99-hour clock is set from the front-panel keyboard; elapsed time starts automatically when the power is turned on. The 2030A automatically annotates the tape with the selected time whenever it prints data.

Multi-instrument Scanning

The 2030A's microcomputer contains addressing intelligence designed to generate the assigned addresses of Fluke PTI family instruments. Select a print mode and the 2030A automatically begins scanning by sequentially sending addresses on through nine until a measurement instrument recognizes its address. The 2030A then prints both the address and the instrument's current reading, and polls the next instrument having a higher address. A typical printing system might include the 2030A with a 2190A Thermometer and an 8920A Voltmeter. One or more Y2036 PTI Polling Cables are needed for connecting more than one instrument in parallel to the 2030A.

Math Power

Simply enter two 6-digit constants from the front panel and the printer can calculate the difference (delta) or percent difference (%delta) between a preselected reference value and the input data. You can also program the 2030A to scale the incoming data using the general formula mx+b.

Graphic Printing

Select the range of data you want to analyze and the 2030A will plot a dotted graph over a 2 inch full scale band of tape. Simply program the right and left limits of the graph area as if they were 0% and 100%. Whether the measurement range is "0 to 1000" or "500 to 510" the 2030A automatically expands or contracts the range to fit within the 2 inch scale, and dot by dot plots a graph of the data you're recording.

Alarms

To control and monitor processes, the 2030A gives you the ability to continuously compare the reading of a measuring instrument against two programmable limits with six-digit resolution. If the reading exceeds either the high or the low limit, the 2030A prints the reading, the time, and activates an alarm output.

When the 2030A is in its trace mode, the edge of the graph also act as alarm set points.

2030A (TemPak Series)

Engineering Units

The 2030A can be programmed to annotate data with the engineering units you choose. It overrides the basic measuring instrument's units with four alphanumeric symbols. Use this feature for math scaling and offset to put converted data in the proper units, or to indicate % when printing percent or difference (%delta).

Mode and Function Identification

Each print mode and special function has a distinct label. At the beginning of each print cycle, the 2030A automatically prints the appropriate labels so you know just what operations are to be performed. In the "interval limit" mode, for example, the 2030A prints Hi and Lo followed by the values assigned to each limit.

All labels include real time or elapsed time when in use, instrument address, and a 6-digit header (HD) to indicate the month, day and year or other meaningful documentation. The diversity of symbols and special diagnostic messages add up to data that's easy to interpret today or weeks from now.

Specifications

Technical Specifications

Printer Type: Thermal, 20-column
Characters: 5 x 7 dot matrix
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,s,μ,z
Print Rate: One line for each linefeed command, 3 lines/second max
Spacing: 6 lines per inch (approximately 2.4 lines per cm)
Paper: 2.5 inches wide, 240-foot roll.
Paper Advance: Stepping motor, belt drive
Buffer Storage: 1 line of data
Dacimal Point: Automatically printed in correct location
Print Head Test: Test pattern printed in all columns if paper advance depressed within 1 seccond of power turn on
Print Modes: SINGLE, CONTINUOUS, INTERVAL, INTERVAL LIMIT, TRACE, INTERVAL TRACE, and REMOTE (operated by contact closure, TTL- or DTL-compatible)
Programmable Units: Up to four characters programmed from front panel. Code set is 64 upper case ASCII characters plus °,f,k,m,p,Ω, s,μ and z. Overrides incoming units.
Programmable Parameters: TIme, Interval, Header, A constant, B constant, Hi Lin, Lo Lim, Units, Spec Adr. All are programmed from front panel.
Clock: Internal crystal. Will measure time intervals and either elapsed time or real-time. Resolution is one second; range is 99 hours, 59 minutes, and 59 seconds. Four modes: Elapsed time only, real-time only, elapsed time and time interval, or real-time and time interval. Real-time runs continuously and elapsed time is reset at the start of each print cycle.
Alarm: Two 6-digit setpoints, assignable, corresponding to six least significant digits of any one measurement instrument. Output is open collector, 28V max. Sinks 30 mA max.
Graphic Printing: Trace is programmed by proper selection of A and B constants. Operates on one instrument. Graph scale is 2-1/8 inches (100 dots) wide. Ten percent scale markers printed. Accuracy ±2% of graph scale.
Math: Programmable to do scaling, delta, and % delta computations by proper selection of A and B constants. Operates on one instrument. Six-digit printout, maximum. Accuracy dependent on scale selected.
Compatible Instruments & Options: 2180A-002, 2190A-002, 2300A-006, 7220A-521, 7250A-521, 7260A-521, 7261A-521, 8920A-521, 8921A-521, 8922A-521
PTI Polling: Prints sequential readings from up to nine Fluke measurement instruments with each having an internal preset address as follows: Adr 1 — 2180A, 2190A, 2300A; Adr 2 — 7250A, 7260A, 7261A; Adr 3 — 7220A; Adr 4 — 8920A, 8921A, 8922A; Adr 6 — 2180A, 2190A, 2300A; Adr 7,8, and 9 — Indirect Addresses. When a thermometer accessory is attached to the 2180A or 2190A via the thermometer accessory connector, the combination of thermometer and accessory acts as one instrument when polled.
Thermometer Interface: Plug compatible with 2180A/2190A with 21X0A-002 output option installed
Scanner Interface: Plug compatible with 2300A Scanner. The 2180A or 2190A Thermometer attached to the 2300A Scanner does not require a 21X0A-002 output option.
Interface: Through 36-pin AMP CHAMP, male connector. Signals: Data, 8 lines; Address, 4 lines; Address Valid; Data Valid; Data Acknowledge; Scan in Progress.

General Specifications

Safety: IEC 348 Protective, Class 1
Temperature: 0°C to +50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤95%, 0°C to 25°C; ≤75% to 40°C; ≤45% to 50°C
Power: 11 to 15V dc, 90 to 132V ac, or 180 to 250V ac, 47 to 440Hz, 40 VA maximum
Size: PTI style D case — 13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in x 8.05 in x 12.85 in)
Weight: Approximately 9 lb with paper
Included: Manual, power cord, one roll of paper

Ordering Information

Model	January 1989 prices
2030A Printer w/Fluke PTI Interface	$1450

Interconnecting cables not included. Order Y7203 or Y7204

Accessories (Also see page 485)

Y2016 7" Rack Adapter, Single	95
Y2017 7" Rack Adapter, Double	95
Y2021 Panel Mounting Kit	95
Y2035 Thermal Paper, box of 10 rolls	68
Y2036* PTI Polling Cable	83
Y7203 2 ft Cable, 36 pin PTI	55
Y7204 5 ft Cable, 36 pin PTI	70

** Required when 2 or 3 measurement instruments are simultaneously connected to 2030A. Use two cables for 4 or 5 instruments.*

Service & Support

Warranty

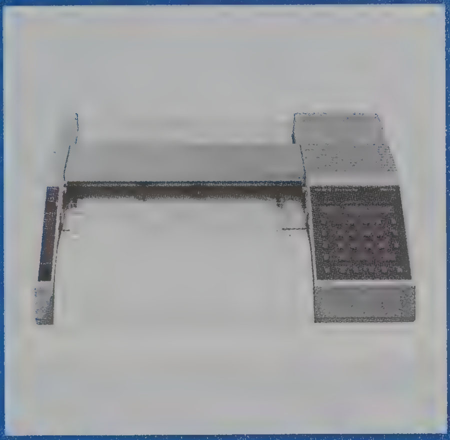
One-year product warranty. See page 470 for further information on warranty terms and conditions.

Extended Warranty

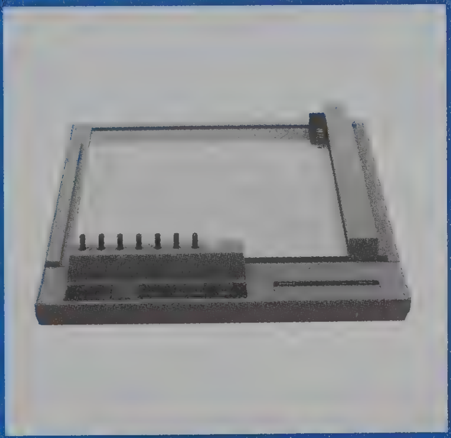
SC1-2030A Repair (w/calibration)	113

Recorders & Plotters

Page 458 PM 8238



Page 462 PM 8272



Page 464 PM 8155

The simplest and quickest method of measuring and permanently registering a low frequency signal is with an analog recorder. Fluke and Philips provide a choice of XY recording (signal vs. signal) and line recording (signal vs. time) combined in the versatile PM 8271 single pen and PM 8272 two pen recorders, covering many measurement applications.

In system applications and for hard copy of digital oscilloscope displays, the PM 8155 digital plotter excels. With both HPGL and Philips GL as standard, GPIB/IEEE-488 or RS-232 interfaces, and a large 32K byte input buffer, plotting of measured data is both fast and simple. For repeated plot applications, an automatic feeder is available.

For measurement and recording of up to 30 voltage or temperature inputs, the PM 8238 multipoint recorder offers the combined advantages of traditional graphic recording as well as numerical recording. With its reliable thermal print system, the PM 8238 is ideal for long term recording of tests and monitoring applications.

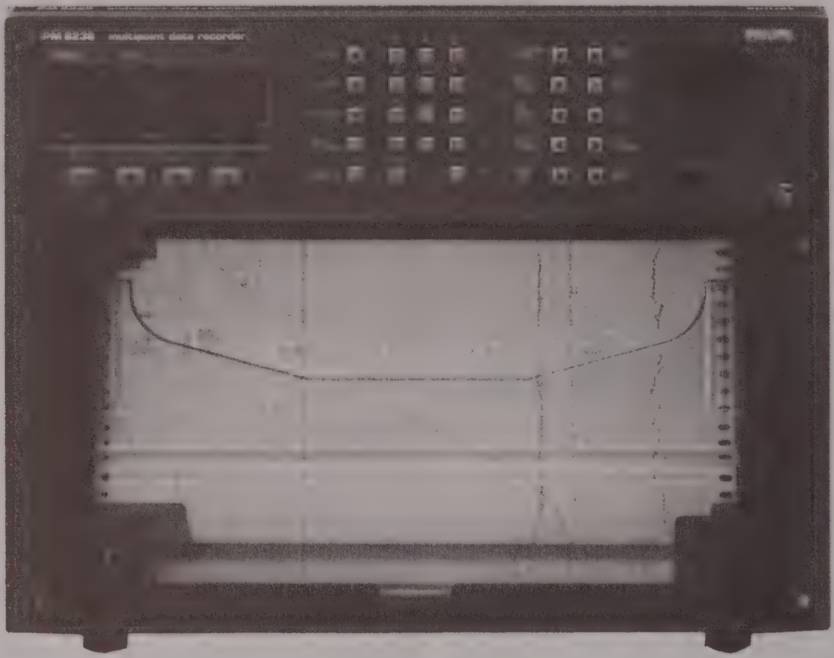
Multipoint Data Recorders 458

Universal Recorders 462

Digital Pen Plotters 464

PM 8238

NEW



PM 8238

PM 8238 Multipoint Data Recorder
Maximum 30 input channels, scanned at 10/s
Graphic or numeric data presentation
Optional alarm output plug-in cards
Interpolation between measuring points for continuous line-plots
Memory modules for user-program storage
AX + B scaled measurements
Maintenance free thermal printing

The PM 8238 is a 30 channel data recorder of the highest quality and reliability and is specifically designed to be set and left running for extended unattended operation. It offers real measurement versatility with features such as memory modules, which allow storage of settings. It can directly record voltage or temperature, with a wide choice of sensors in 2- or 4-wire configurations. Scanning takes only 100 ms/channel, for quick alarm detection. Individual measurement values are presented on a front-panel display: chart output can be numeric for clear presentation of values; graphic, for spotting trends; or both in combination.

Dependable Plotting, Durable Construction

The PM 8238 has been designed and constructed to give the highest quality and reliability in operation. Very reliable low noise reed relays are used for channel switching. The relays are tested to three times the normal operating life of the instrument. The number of components and PCBs is less than in similar instruments and the wiring has been reduced, cutting the chance of instrument failure; and special attention has been given to a rugged, durable construction. Quality and reliability is such that a high MTBF has been achieved.

Printing is by a high quality, maintenance free thermal print head. The user does not have to change pens, replace ribbons, fill ink reservoirs or clear inkjets. The head is virtually unaffected by dusty environments, ensuring sharp, quality plots throughout the life of the instrument.

To match the quality and reliability, the PM 8238 offers high accuracy and has a very broad spectrum of functions.

Systems Use

This instrument is ideally suited for unattended, preprogrammed operation, where the reliability is of maximum benefit. With optional IEC-625/IEEE-488 (GPIB) or V24/RS 232-C interfaces, operation in a computer controlled environment is possible. These allow various functions such as output of measured values to a computer/controller, remote control and set-up, presetting and programming and synchronized measurements. An optional extended TTL-control interface card provides remote control of some other functions such as chart speed, scan start, channel changing and printing event markers, all via TTL level signals. At any time, a complete survey of parameters can be requested.

Comprehensive Presentation Capabilities

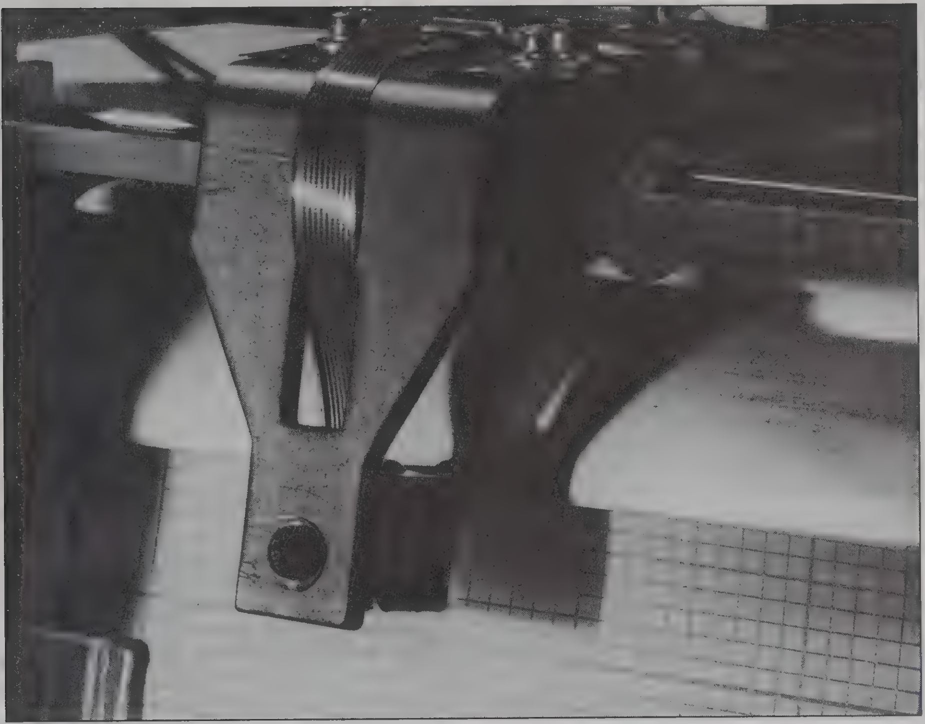
The full scale definition of 1000 dots represents a resolution of 1 µV over the 250 mm (10 in.) plot width (at 1 mV span). Each channel is stamped with its number and the plots are date and time stamped if required, allowing easy archiving and copying of plots for distribution. Measurement speed is such that all 30 channels are scanned in 3s; this makes the PM 8238 ideal for real-time monitoring and control of many variables; it also provides for quick reactions to alarms. Because of the high speed, it can also be used for monitoring cause and effect on adjacent channels and for most applications, the plotting on such channels may be regarded as simultaneous. Charts are plotted on standard z-fold 250 mm (10 in.) wide thermal paper.

The AX + B scaling function allows display of the appropriate range for the variable: for example when operated with a humidity sensor, instead of displaying the mV output, that channel can be scaled to read from 0...100%.

In standby mode, input from the front panel or from a controller in a system set-up is directly recorded on the chart. Other information recorded on the chart includes chart speed; temperature at the isothermal input block for cold junction compensation; alarm points; functional units - V, °C or scaled; and the time of unexpected events such as power interruption. Dot density is alterable for each channel if the operator wishes one to be highlighted.

Numeric or Graphic Mode

Numeric mode directly outputs the values of individual measurements, in a 10-column tabular form, and this mode can be instantly selected at any time while recording. It can also



print out automatically, at user defined intervals of one minute from 1 to 99, allowing quick overviews of actual measurement results. Printouts include codes to show fault conditions such as out-of-scale, under-scale, thermocouple break or alarm conditions met.

Graphic mode gives optimum interpretation of results. It has a switchable interpolation mode that fills in dots between the actual measurement points. This gives continuous line plotting for direct detection of trends, peaks and irregularities. The fast measurement time (100 ms/channel) ensures the user can interpret events virtually in real-time. Comprehensive zero suppression facilities permit a flexible choice of scale positioning, so together with a chart speed continuously variable over 60 mm/min to 60 mm/h, optimum use is made of printout area. Multiple readings in the same range can be re-scaled for immediate comparisons. Direct plots can also be automatically made of the difference in measurements on different channels, speeding up comparisons and eliminating the potential for calculation error. A numeric print out can be selected automatically, while in graphic mode, at user defined intervals in steps of 10 minutes.

Simple Yet Versatile Operation

No previous knowledge of the instrument, or knowledge of software or programming are needed to operate this instrument. All tasks such as linearization and mixing of variable measurements on different channels are automatically handled by the recorder. PM 8238 can handle any combination of voltage or 2- or 4-wire temperature measurement on the maximum 30 channels (15 for 4-wire operation). Parameter settings are entered directly at the instrument keyboard, or from a remote PC or controller via one of the systems interfaces. All function keys have an LED to indicate activation. Keyboard settings are lockable to prevent accidental changes.

Programming is simple, via front panel keystrokes and clear error messages are provided. The range of possibilities for unattended operation is extended by the programming modules which can store settings. There is even a “copy channel” function for fast repeat programming.

Voltage Measurements

Choice of voltage ranges up to a maximum of ±30 V, with spans of 1 mV to 30V. The zero suppression facility allows the span to be located as a window over the selected range, and is entered by typing in the zero- and full-scale values of the window.

Temperature Measurement

Pt 100 uses the 4-wire connection, eliminating errors due to wire resistance; and the low 0.77 mA source current prevents self-heating.

For thermocouples three different forms of cold junction compensation are provided:

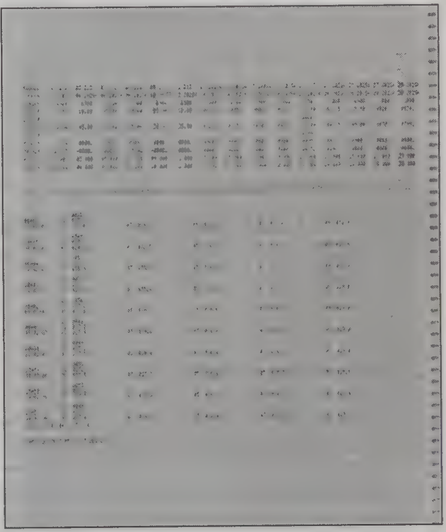
- automatic
- fixed at 0°C, 20°C or 50°C
- compensation from any other channel, eliminating the need for long compensation wires if the instrument is not near the measurement point.

Cold junction compensation is achieved by a built-in isothermal block ensuring <1/4°C difference between terminals. The block is in a lockable compartment at the back, to protect it from any external effects such as direct heat radiation or convection. The difference measurement facility also helps eliminate cold junction errors; it automatically calculates the difference in readings beeen two channels, greatly reducing this type of inaccuracy (common to two channels).

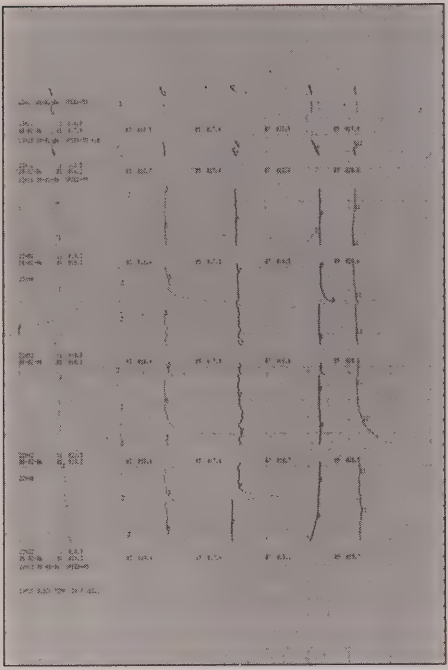
Linearization is automatic for the 4 most common thermocouples: J-, K-, S- and T-type, with options for R-, B-, E-type, Nicrosil/Nisel and Ni-Ni. The zero suppression facilities described in the voltage measurement section are also available for temperature measurement. Error messages alert the operator if something goes wrong such as a break in thermocouple connection.

Alarms

The alarms may initiate one of several responses: e.g. increasing line intensity, print only on alarm or vary the chart speed. The PM 8328 unit provides for a maximum of two alarm cards to provide several alarm combinations. Slot 1 provides one minimum alarm and one maximum for odd numbered channels; slot 2 the same for even numbers. The cards simply plug-in and two common contacts for min/max values are provided.



PM 8238



Specifications

Technical Specifications

Voltage Measurements

Ranges and Spans:

Function	Permitted span	Full- and zero-scale limits	Range
mV	1...30 mV	-30...+30mV	30 mV
	5...300 mV	-300...-30 mV +30...+300 mV	300 mV
	50...3000 mV	-3000...-300 mV +300...+3000 mV	3000 mV
V	0.5...30 V	-30...+30 V	30 V

Accuracy: ±0.1% of input value ±0.1% of span
Temp. Coefficient of Accuracy: 0.2% of the input value per °C

Input:
Input Offset Voltage: <5 µV (= 1.25 mm at span of 1 mV)
Input Offset Voltage Drift: <0.5 µV/°C
Input Current: <100 pA
Input Impedance: 10 MΩ
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Possible Input Configurations: 2- and 4-terminal
Common Mode Rejection Ration (CMRR): >132 dB for DC
Series Mode Rejection Ration (SMRR): >38 dB for 50 and 60 Hz ± 1%
Measurement Time: 100 ms per channel

Thermocouple Measurements

Thermocouple Types:
J-type (Fe-Const)[1]
L-type (Fe-Const DIN)
K-type (Chromel-Alumel[1] + DIN)
S-type (Pt-Rh 10Pt[1] + DIN)
T-type (Cu-Const[1])
U-type (Cu-Const DIN)
[1] IEC 584-1, IPTS 68

Ranges and Spans

Type	Permitted span	Full- and zero-scale limits °C (see note)	Range
J, L	25...700 250...850	-200(-50)...+500 -100(-20)...+705	500 750
K	30...900 300...1470	-200(-50)...+700 -100(-20)...+1370	700 1370
S	250...1600	0...+1600	1600
T, U	35...600	-200(-50)...+400	0400

Note: The minimum input temperature above which full resolution (100 points) is obtained at the minimum span is indicated between brackets.

Accuracy (excl. Thermocouple): basic accuracy ± cold junction contribution ±0.1% of span

Basic Accuracy (over rated temp. range):

Type	Range	Basic Accuracy
J, L	500°C	±0.1%, T_{in} ±0.2°C (±0.55°C, T_{in} <50°C)
	750°C	±0.1%, T_{in} ±0.3°C (±0.4°C, T_{in} <-20°C)
K	700°C	±0.05%, T_{in} ±0.35°C (±0.75°C, T_{in} <-50°C)
	1370°C	±0.1%, T_{in} ±0.7°C (±0.8°C, T_{in} <-20°C)
S	1600°C	0.1% T_{in} ±1.3°C
T, U	400°C	±0.1%, T_{in} ±0.3°C (±0.6°C, T_{in} <-50°C)

Cold Junction Contribution: ≈ 1.2 x cold junction

Cold Junction Accuracy:
Measured Internally (Automatic): ±0.45°C ± 0.02(T_{amb} - 23)°C
Measured Externally (in Channel NN): Accuracy of external channel NN
Fixed (at 0°C, 20°C or 50°C): accuracy of external supplied temperature
Input Configurations: 2- and 4-terminal
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Measurement Time: 100 ms per channel

PT 100 Measurements

Pt 100 Temperature Measurement Current: 0.7685 mA
Span: 25...1050°C (span is the difference between the selected full-scale value FSV and the selected zero-scale value ZSV)
Full- and Zero-scale Limits: -200...+850°C
Accuracy (excl. Transducer): ±0.10% of T_{in} ± 0.25°C ± 0.06(T_{amb} - 23)°C ± 0.1% of span
Linearization: Acc. to DIN 43760/BS 1904: 1964
Input Configuration: 4-terminal input
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Measurement Time: 100 ms per channel

Resistance Measurements

Transducer Resistance: 0...3.9kΩ
Measuring Current: 0.7685 mA
Accuracy of the Current: ±0.015%
Temperature Coefficient of Current Source: 0.005% per °C
Input Configuration: 4-terminal

Differential Measurements
A channel X can be programmed to measure the difference relative to another channel Y

Alarm Relay (in PM 8238 and PM 9895)

Contact Ratings:
Switched Power: 10 W max.
Switched Voltage: 45 V_{DC} or 30 V_{AC} max.
Maximum Voltage between Contacts and Earth: 42 V_{DC} or 30 V_{AC} (rms)
Alarm to Contact Closure Time: depends on number of measured channels
Current through Closed Contacts: 2 A, DC or AC (rms) max.
Contact Resistance: 50 mΩ

General Specifications

Mains Voltage (Factory Set): 220...240 V_{AC} ± 10%; 110...127 V_{AC} ± 10%
Mains Frequency: 50 Hz ± 5% (can be set to 60 Hz)
Electrical Safety: Acc. to IEC 348 class 1; VDE 411 class 1
Dimensions (h x w x d): 284 x 352 x 444 mm (incl. feet)
Weight: Approx. 13 kg.
Climatic Conditions: Acc. to IEC 359, C1 tested acc. to IEC 68
Rated Temperature Range: operation within spec, +5...+50°C; limits of operation, 10...+50°C
Humidity: 20...80% RH non-condensing
Max. Dewpoint Temp: 26°C
Storage and Transport: Acc. to IEC 359; temperature -40...+70°C
Reference Conditions: Acc. to IEC 359; temperature 23°C ± 2°C; humidity 45...75% RH
Warm-up Time: 30 Minutes

Resolution:
Recording in Dot Mode: 0.1% of span (1000 points)
Recording in Numeric Mode: absolute value of the measured input with signal printed to four digits
Displayed Value: absolute value of the measured input with signal indicated to four digits.

Included with the instrument:

- package of 5 books of folded thermo-sensitive paper (20 m each), black imaging
- 2 fuses 1.6 A-T
- mains cord
- paper output tray
- program module
- operating manual "PM 8238 Multipoint Data Recorder"
- operating manual "PM 8238 Interfaces to other devices"

KS 8238 Industrialized Configuration

This multipoint recorder comes in two mainframe versions. The PM 8238 is designed for laboratory/bench top environments while the KS 8238 is designed for more industrial/systems environments. Both mainframe versions use the same internal hardware and software components. They differ only in packaging. The KS 8238 comes with all of the hardware necessary to panel mount standard. It also has a locking, gasketed front panel that covers the entire front of the instrument. This makes it more impervious to dusty and dirty environments as well as providing additional security against operator error. The KS 8238 also does not have a main power switch to make it easier to slave it off of the system power.

Ordering Information

Model

January 1989 prices

PM 8238/013 30 Channel Multipoint Recorder	$5500
KS 8238/013 30 Channel Multipoint Industrial Configuration Recorder	5950

Accessories

PM 9141/02 3 Program Modules	$175
PM 9838/20 19 inch Rackmount Unit	140
PM 9890/02 RS 232C/V24 Interface	800
PM 9891/02 IEC-625 Interface	950
PM 9893/01 Extended Control Interface	350
PM 9895/02 Alarm Relay Card for 15 channels	525
PM 9930A/03 5 books Z fold Paper, length 20m	90

Additional Thermocouple Linearization Units

PM 9897/03 Type R (0...1765C)	450
PM 9897/13 Type B (250...1820C)	450
PM 9897/23 Type E (-200...400C)	450
PM 9897/33 Type E (-100...1000C)	450
PM 9897/43 NiCrSi/NiSi (0...800C)	450
PM 9897/53 NiCrSi/NiSi (0...1200C)	450
PM 9897/63 Ni/Ni, 18% Mo (0...1400C)	450

Cables

Y1707 2m Cable for RS 232C	125
Y1705 RS 232C Null Modem Cable	75
Y8022 2m Cable for IEEE-488	145

Service & Support

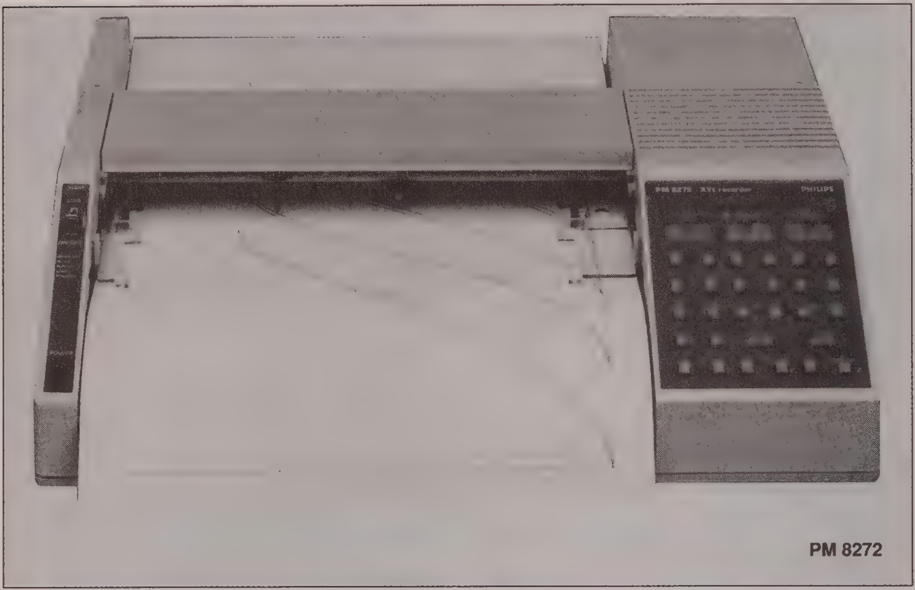
Warranty

One and a half year warranty. (See page 470 for further information on warranty terms and conditions).

Note: The above configurations meet North American requirements. For other power options see page 491.

PM 8271 & PM 8272

GPIB
IEEE-488



PM 8272

PM 8271/PM 8272 Universal Recorders
XY and Xt (line) recording, single or dual pen
A3, A4, A and B size sheet or Z-fold paper
High slew rate to record fast signals
24 timebase settings/chart speeds (including 10 user programmable)
40 µV/cm to 2 V/cm sensitivity (1 mV to 50 V full scale)
Auto-zero suppression
Optional rackmount kit available

The PM 8271 single pen and the PM 8272 dual pen recorders offer precision XY and line recording in the same instrument, with many functions built-in for both modes. Now you can have top quality XY and Xt recording without having to specify two instruments. They can be used with sheet paper up to ISO A3 (297 x 216 mm)/ANSI B (11 x 17 in.) size, or with Z-fold paper for charts or multiple X-Y recordings.

Most XY recorders hold the paper stationary on a flatbed writing surface, and then move the pen in X and Y axis. The PM 8271/72, however, moves the paper in one axis, and the pen is then moved in a perpendicular axis. The result is superior versatility for both XY and Xt recording.

The PM 8271/72 range of standard functions includes automatic paper edge detection and sheet positioning for A3, A4, A and B size paper for simplified X-Y recording. When Z-fold paper is used, these recorders offer a large flat-bed area for convenient note-taking. Throughput is very high as there is no need to wait for electrostatic chart holds to release (as on standard flatbed XY recorders). Other problems related to electrostatic chart holds such as paper bubbling and susceptibility to dust are also eliminated.

X-Y Recording

For recording one measurement parameter versus a second (generally not time), the PM 8171 provides a reliable, accurate paper transport, high sensitivity input, timebase and remote control interface.

The PM 8272 expands on this performance, with dual pan performance to record two parameters versus a third.

Line Recording

As line recorders, for recording one or two parameters versus time, the PM 8271/72 have high input sensitivity and exceptional long-term stability, making them ideal for product endurance tests requiring consistent, precision recording over extended periods.

They have a unique auto zero-suppression mode, which ensures fast connection to unknown signals by automatically setting a calibrated offset. This facility will read just the zero-suppression if the measured signal moves off-scale. With this feature it is possible to make unattended high resolution measurements without the risk of losing important information through off-scale pen movements.

The PM 8271/72 have low-cost temperature inputs covering PT100, J-type and K-type thermocouples. These simply plug into the rear panel of the recorder, and provide full linearization and cold junction compensation.

Optional accessories such as event markers and rack mounts, plus wide-range mains and DC power supplies further increase the versatility of these instruments.

Keyboard Operation

A keyboard with full LCD indication for each channel setting has replaced the conventional rotary switches, making all recording functions instantly accessible. To ensure that important tests cannot be disturbed by unauthorized personnel, a keyboard disable function can be used to prevent keyboard access.

Enhanced Recording Features

The PM 8271/72 feature a variety of improved performance features. A diagonal speed of more than 130 cm/s for sheets in the X-Y mode ensures accurate tracking of incoming signals.

Recording versatility is enhanced through a selection of 25 measurement ranges for both the X (chart) and Y (pen) channels. These range from 40 µV/cm to 2V/cm, equating to full scale inputs from 1 mV to 50V. This large range often eliminates the need to use uncalibrated measurements for signals just above the range limits.

For the chart channel, user-programmable chart speeds or time-base settings allow custom settings to meet the needs of specific applications. Chart speeds can be set as required in the ranges 30 to 1200 mm/min. and 10 to 1200 mm/h.

Where measurement signals with DC offset are to be recorded, PM 8271/72 have 7 calibrated zero-suppression levels covering signal offsets of up to 500%. With this high performance level, special care has been taken to avoid measurement errors caused by noise and spurious signals, resulting in a CMRR of 150 dB for these recorders.

Bench, Rack or Field Operation

The PM 8271/72 will operate on a wide-range of power supplies. The high efficiency switched-mode power supply can be used on power voltages of 115V or 230V (+/-15%) without switching. A separate 24 VDC input is also provided as standard for convenient field operation.

The recorders are compact, making them ideal for bench use, while the optional slide-in rackmount allows them to be built quickly and easily into larger measuring systems housed in 19-inch rack units.

Logic, RS 232 or GPIB Interfaces

The PM 8271/72 have a standard logic-level external control input for system measurements which allows basic functions like penlift, servokill, dipmarking and chart speed to be controlled. Alternatively, bus-controlled operation, via the RS 232/V24 and GPIB interfaces, enable functions like range and zero-suppression to be controlled. This makes these recorders suitable for integration into complete system measuring applications.

Advanced Mechanics and Materials

The use of high-density, engineering-grade polycarbonate casings provides outstanding mechanical properties in terms of rigidity, dimensional stability and durability, as well as giving an attractive appearance. A special injection molding technique results in extremely fine mechanical tolerance, so that each part fits exactly.

This construction technique ensures a high degree of functional integrity, as well as consistent high quality in manufacture through elimination of traditional assembly procedures involving numerous individual components.

MTBF of over 20,000 Hours

These two recorders use the latest, thoroughly proven technologies in both electronics and mechanical construction, ensuring an outstanding specification and full conformity with all applicable safety regulations.

The 8271/72 are manufactured in Philips' new instrument factory, using high quality components and advanced manufacturing processes (NEN 2646 approved). Application of stringent quality-assurance standards is an essential and integral part of the overall manufacturing process. With this advanced technology in design and manufacture, it has been possible to achieve an MTBF figure of more than 20,000 hours for these recorders.

Specifications

Technical Specifications

Types: PM 8271 single pen and 8272 dual pen
Modes: XY and Xt (line) recording

Media Sizes

For XY Modes: For XY or line modes Z-fold sprocket paper, 20m long (PM 9920 types)
ISO A4: 210 mm x 297 mm (8.27 in x 11.68 in)
ISO A3: 297 mm x 420 mm (11.69 in x 16.54 in)
ANSI A: 279 mm x 216 mm (11 in x 8.5 in)
ANSI B: 432 mm x 279 mm (17 in x 11 in)
Maximum Writing Area (XY mode): 250 mm x 380 mm (9.84 in x 15 in)
Variable Sensitivity Adjustment: By potentiometer from calibrated span (0.5 to 1.0 times span)
Accuracy: <0.25% fsd
Dead Band: <0.2% fsd
Linearity: 0.1% fsd
Calibrated Zero Suppression: 0%, 50%, 100%, 150%, 200%, 300%, 400%, 500% of range
Variable Zero Suppression, for both Chart and Pen Channels: By potentiometer from -5% to +105% of range
Input Impedance: 1 MΩ
Input Type: Floating
DC CMRR for Chart and Pen Channels: >150 dB
AC CMRR (<100 kHz): >130 dB
AC CMMR (50/60 Hz): >56 dB
Maximum Input Voltage: 30 VDC: range <500 mV fsd; 42 VDC: range >500 mV fsd
Timebase/Chart Speeds: 14 fixed speeds of 10, 20, 30, 60, 120, 300, 600 and 1200 mm/h; and 30, 60, 120, 300, 600 and 1200 mm/min. plus 10 user definable speeds
Power: AC: 115 or 230V 15%, 50 to 60 Hz (no switching required)
Dimensions: 132 mm H x 444 mm L x 345 mm W (5.2 in H x 17.4 in L x 13.5 in W)
Weight: 5 kg (11 lb)
Safety Approvals: IEC 348 class 1
Environment Approvals: IEC 359 class 1 (C1, M1, S2)
Operating Conditions: +5 to 40°C, 20 to 80% RH
Storage Conditions: -40 to +70°C, 5 to 95% RH
EMI: VDE 0871 B, VFG 1046
Warm-Up Time: <30 minutes

Chart/Y Channel

Calibrated Input Sensitivity: 25 calibrated ranges from 40 µV/cm to 2 V/cm in a 1:2:4:5:8: sequence
Writing Speed: Sheet paper 90 cm/s; Z-fold 30 cm/s
Step Response Time: Sheet paper 0.9s; Z-fold 0.28s (over 250 mm)

Pen/X Channel

Calibrated Input Sensitivity: 25 calibrated ranges from 40 µV/cm to 2 V/cm in a 1:2:4:5:8 sequence (Equivalent to 1 mV to 50V fsd)
Writing Speed: 100 cm/s
Step Response Time: 0.25s
Penlift: Front panel or remote control
Supplied with the Instrument: Two pens per channel, 50 sheets A3 paper, one packet Z-fold paper, fuses, operating manual, cleaning brush, potentiometer oil, screwdriver, sheet paper guide, dust cover, AC power cable, DC power cable, remote control DIN connectors.

Ordering Information

Models

January 1989 prices

PM 8271/01 Single Pen XY/Line Recorder	$1850
PM 8272/01 Dual Pen XY/Line Recorder	2650

Accessories

PM 9870/10* Left Hand Event Marker (only available as factory-fitted option)	175
PM 9870/20 19-inch Rackmount Kit 3E high	on req
PM 9870/30 Sliding Rackmount Kit	175
PM 9870/40 Dust Cover (not for use with PM 9870/30)	125
PM 9191/02* GPIB Interface	350
PM 9190/01* RS 232 Interface	350
PM 9877/01 Pt 100 Unit	200
PM 9877K/2 K Type Thermocouple Unit	200
PM 9877J/2 J Type Thermocouple Unit	200

** Must be factory installed. Please state these options clearly when ordering.*

Consumables

PM 9856/05 10 Blue Pens for PM 8272 (lower channel)	50
PM 9857/05 10 Red Pens for PM 8271 or PM 8272 (lower channel)	50
PM 9857B/05 10 Blue Pens for PM 8271 or PM 8272 (upper channel)	50
PM 9920/00 0 - 10 mm Linear ScaleZ-fold Paper with 10 mm grid (20m)	35
PM 9920/01 100 - 0 Linear Scale Z-fold Paper with 20 mm grid (20m)	35
PM 9920/05 0 -10 mm Linear Scale Z-fold Paper with 20 mm grid (20m)	35
PM 9953/53 Pack of 250 Sheets ANSI B Paper	35
PM 9953/54 Pack of 500 Sheets ANSI A Paper	35

Use of stated paper and pens is recommended for optimum drawing quality. Pen life: if kept covered when not in use, pens will draw lines approximately 1500m long.

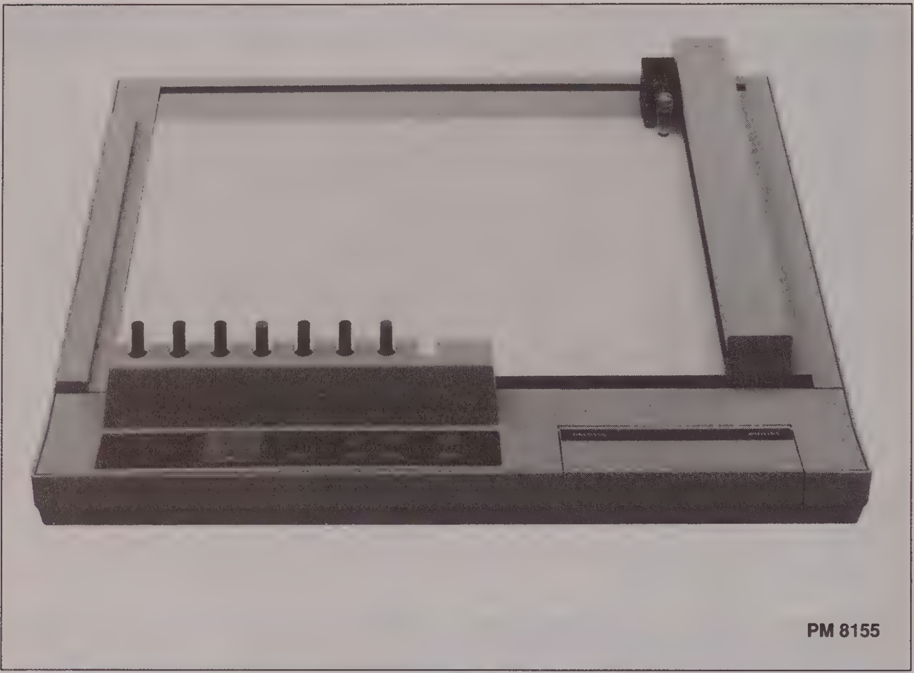
Service & Support

Warranty

One-year product warranty. See Page 470 for further information on warranty terms and conditions.

Note: The above configurations meet North American power requirements. for other power options, see page 491.

PM 8155



PM 8155

PM 8155 Digital Pen Plotter

- 50 cm/s pen speed, 0.05 mm resolution
- Accepts multiple media up to 11 x 17 inch (287 x 410 mm)
- Auto-Sheet feeder
- Full 32k Byte Buffer
- HP-GL™ and Philips-GL compatible, either RS-232C or GPIB/IEEE-488
- 8 Pens/Colors, Automatically Selected

The PM 8155 multicolor plotter meets your hard copy graphics needs with an outstanding combination of performance, versatility and ease-of-use. Compatible with a wide variety of Fluke and Philips instruments, it provides a strong complement to your test systems-as well as supporting your computer-generated graphics needs.

Fast, Precise Performance

This multi-purpose plotter produces easy-to-read graphics in up to 8 colors (all automatically selected) on a variety of media including both paper and transparency, in 11 x 17 inch (ISO A3) and 8-1/2 x 11 inch (ISO A4) sizes.

Resolution of 0.05mm, with reproduceability of 0.1 mm (0.3 mm with pen change) ensures precise, clean graphics. The maximum plot speed of 50 cm/s, regardless of pen direction, provides timely results. Plot speed is also fully programmable in 1 cm/s increments to further ensure superior trace quality.

Expanded Buffer for Improved Efficiency

With a full 32k Byke input buffer, the PM 8155 ensures user-efficiency by being able to accept a large volume of input data. This frees the source instrument (oscilloscope, etc.) or computer from which it is plotting to move on to the next task while the plotter is at work.

Convenient Auto-Sheet Feeder

Efficiency of use is further enhanced by the optional sheet feeder. Accommodating 8-1/2 x 11 inch (alternately ISO A4) sized sheets, the feeder includes a paper cassette and an output stacking tray. Both can easily be added to the plotter with no need for adjustment or modification, making the PM 8155 ideal for unattended production of large series of multiple plots.

Versatile Graphics Language and Interface Options

Built-in intelligence/firmware provides compatibility with both HP Graphics Language (HP-GL™) and Philips-Graphics Language, with simple rear panel selection. Further, both GPIB/IEEE-488* and RS-232C models are available, assuring compatibility with a wide variety of application needs.

The versatile PM 8155 can also be used as a straight-forward printer, printing out all data as received, including control characters and delimiters. This allows incoming data to be analyzed, providing information about the computer or instrument/plotter combination.

Added Fluke & Philips Compatibility

The PM 8155 is ideal as an output device for a variety of other Fluke and Philips instruments. Interface it directly to the PM 3350 or PM 3320A digital storage oscilloscopes, for example, with the need for a controller, to provide high resolution, hard copy documentation of both the signal and the scale factors displayed on the CRT. Add the Auto-Sheet feeder, and the DSO's Auto-Plot feature lets you document long series of single-shot events-unattended.

Specifications

Media Sizes: ANSI-A: 8 1/2 x 11 in; ISO A4 (210 x 297 mm). ANSI-B: 11 x 17 in; ISO A3 (297 x 410 mm)

Maximum Plotting Area: 11.3 x 16 1 in (297 x 410 mm)

Paper Hold: Electrostatic

Pens: 8 (or 7 + digitizing reticle); [7 (or 6 + digitizing reticle) when paper feed used]

Pen Type: Fibertip, transparent, permanent, liquid ink drafting

Media: Paper, transparency

Resolution (min. addressable step size): 0.05 mm; 0.025 mm internally

Reproduceability: 0.1 mm; 0.3 mm (after pen change)

Pen Velocity (max axial): 50 cm/s, programmable from 1-50 c/ms, in 1 cm/s steps

Pen Acceleration: Max 0.3g with pen down

Interfaces: IEEE-488; implemented functions SH1, AH1, T6, L3, SR1, RL0, PP1, DC 1, DT0, C0, E1. RS-232C; Terminal wiring, full duplex, protective ground, baud rates 300-9600

Input Buffer: 32k Byte

HP-GL Character Fonts: US ASCII, French, German, Swedish, Norwegian, English, Italian, Spanish, Portuguese, Katakana. Additional user-defined characters

HP-GL Compatibility: PM 8153, HP 7475

Philips GL Character Fonts : US ASCII, French, German,Spanish, Swedish

Philips GL Printing Styles: Matrix, Simplex, Mulitiplex

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 8155

Philips GL Compatitibilty: PM 8151, PM 8153, PM 8154, 297 mm sizes, capacity 100 sheets, comprising paper cassette and stacking tray
Automatic Paper Transport: Optional sheet feeders for 8-1/2 x 11 in or 210 x 297 mm sizes, capacity 100 sheets, comprising paper cassette and stacking tray
Power Supply: 115 or 230V ±15%, 50-60Hz
Temperature Range: 5 to 40°C (operating); -27 to 70°C (storage)
Size: 170 H x 555 W x 483 D mm
Weight: 11.2 kg net, (30.02 lbs); 13.5 kg (39.19 lbs) with paper feed unit
Included: User Manual, Protective Cover, Fibertip Pens (red, blue green, black) 2 each, Digitizing Reticle, Pad of 11 x 17 in (287 x 410) mm) paper (50 sheets), Fuses, Power Cord, Soft Plastic Dust Cover
Power Comsumption: 45 VA

Ordering Information

Models

January 1989 prices

PM 8155B/13 Plotter w/IEEE-488 Interface	$1750
PM 8155S/13 Plotter w/RS-232C Interface	1750

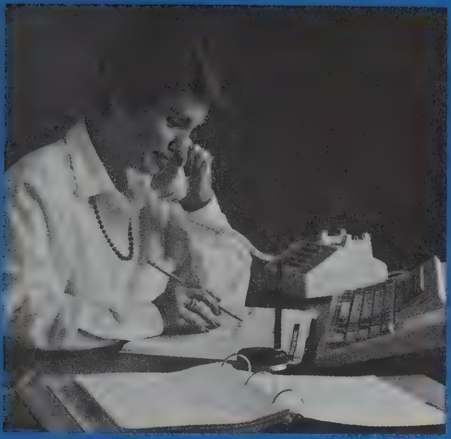
Options

PM 9855/01 Sheet Feeder, 210 x 297mm (ISO-A4) Paper Format	500
PM 9855/51 Sheet Feeder, 8-1/2 x 11 in (ANSI-A) Paper Format	500

Accessories

PM9955/01 Set of 2 x 4 fibertip pens; red blue, black, green	$45
PM 9955/05 Set of 2 x 4 fibertip pens; purple, yellow, violet, brown	45
PM 9876S/901 Set of 10 overhead pens, 5 colors	70
PM 9953/53 Pack of 11 x 17 in (ANSI-B) Paper, (250 sheets)	35
PM 9953/54 Pack of 8-1/2 x 11 in (ANSI-A) Paper, (500 sheets)	35
PM 9953/03 Pack of 287 x 410mm (ISO-A3) Paper (250 sheets)	on req
PM 9953/04 Pack of 210 x 297mm (ISO-A4) Paper (250 sheets)	on req

Customer Support Services


Customer Support

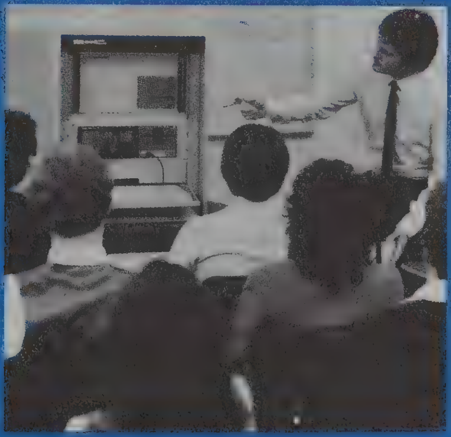
Repair, calibration and system integration

As our customers demand new and more complete test and measurement solutions, Fluke and Philips are becoming more than a manufacturer of affordable, efficient products. We are dedicated to providing the best services possible to support our products in your specific application. To protect your product investment, Fluke and Philips Technical Service Centers are located worldwide to support you with parts, repair and calibration services.

To ensure you realize maximum productivity in your specific application, Fluke and Philips also offer applications and maintenance training, software and systems integration services, and product application consulting.

Extend the quality of your instruments with our Customer Support Services. You can expect responsive service and support that's right for your specific needs.

Training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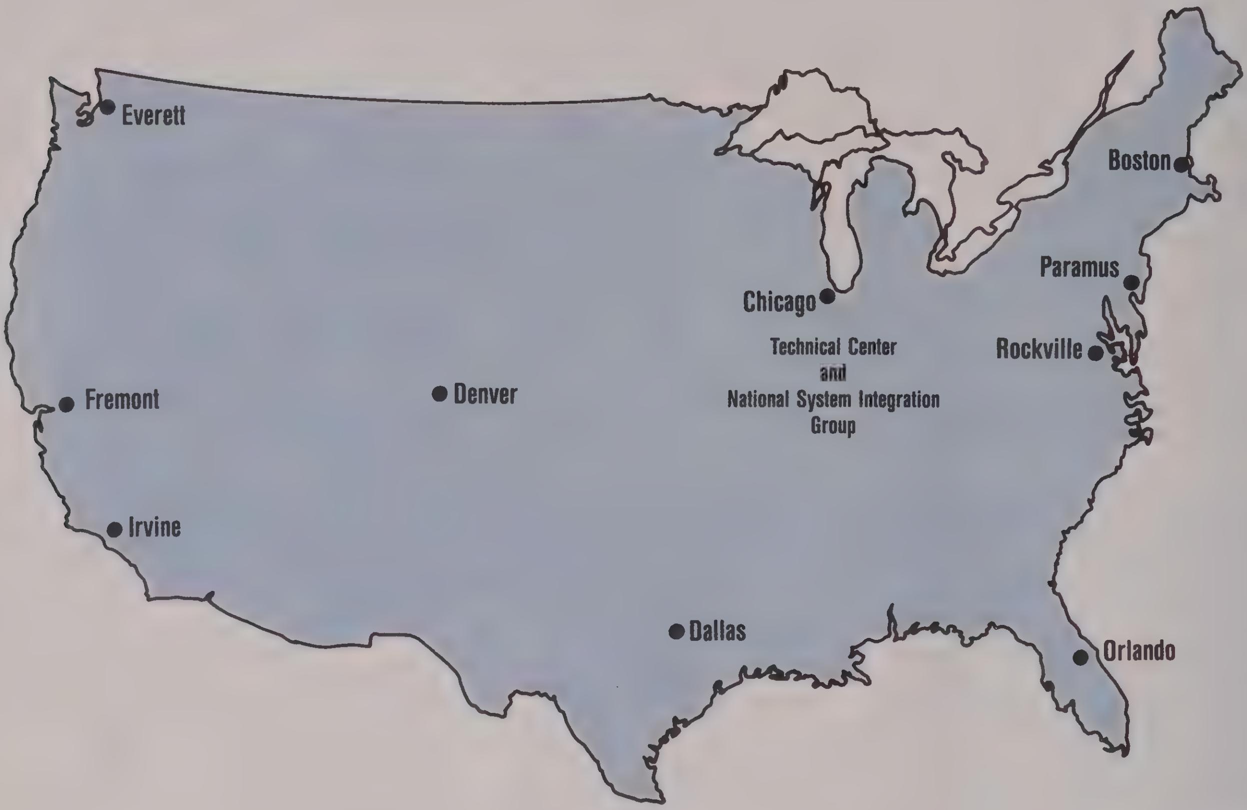
World-wide Technical Service Centers



See page 493 for listing.

Corporate Headquarters

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Philips International B.V.
Test & Measurement
Building TQ III-4
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The Netherlands
Tel: 31 (40) 782300
Telex: phtc nl

Service Offerings

Services	Advantages	Option 1 Performance Verification	Option 2 Calibration	Option 3 Complete Repair	Option 4 Full Service: Calibration & Complete Repair
NEW Full Coverage Service Agreement • OEM	Discount per instrument mix, dollar volume and length of contract	•	•	•	•
Extended Warranty	10% Discount plus significant savings over standard prices (all CRT's are included)	•	•	•	•
Blanket Purchase Order	10% Discount (standard prices)	•	•	•	•
Standard Price Service - Emergency 48 Hour	Savings over Labor & Materials Costs - Special Service	•	•	•	•
Labor & Materials	Out of production/ modified instruments		•	•	•
Service Methods Fluke Technical Center		•	•	•	•
Pick-up & Delivery (selected areas)		•	•	•	•
On-Site		•		•*	

• Indicates availability of service option
**On selected instruments*
Special discount promotions throughout the year.
Discounts cannot be combined with other discounts.

Value-added Services	**Costs**
• 90 Day "Full Instrument" Warranty, including CRT (Storage CRT's included only if replaced)	No Charge
• Service Reports	No Charge
• Calibration Certification/ & Instrument Labels	No Charge
Options	
• Automatic Upgrades	Call Technical Center
• In and Out Calibration Reports	$15 to $75 depending on instrument type
• MIL-STD 45662 Calibrations	"

Self-Maintenance

- Service Parts
- Modular Exchange Program (MEC)
- Recommended Spare Parts Kits (RSPK)
- Upgrade/Service Kits
- Operator and Service Manuals
- Provisioning
- Microfiche Program Includes:
  - Product Change Notices
  - Parts
  - RSPK
  - MEC
  - Manual Index
  - Technical Bulletins/Troubleshooting Information

Metrology Services

- State-of-the-art, primary standards lab
- NIST (NBS) traceability
- Cost-effective, convenient service programs:
  - Traceability Maintenance Programs
  - Standards Calibration Services
  - Support for "1990 Electrical Unit Change"

Calibration & Repair

Calibration and Repair Services

- Variety of services to meet each customer's needs
- 90-day warranty of complete unit
- Installation of product improvements
- Full NIST (NBS) traceable calibration and/or alignment
- Documented quality assurance program
- Compliance with MIL-STD-45662 and nuclear industry standards
- Special calibration data available
- Pick up and delivery services

Each Fluke Technical Center is equipped with the necessary instruments, standards, procedures, and personnel to maintain Fluke and Philips products at peak performance. The procedures and documentation comply with MIL-STD-45662 and Nuclear Regulatory Commission requirements, assuring accuracy traceable to the National Institute of Science & Technology (National Bureau of Standards). Proper use of measurement standards is carefully and continually monitored through a corporate Controlled Audit Program.

Fluke's Customer Support Services is dedicated to a single goal — providing the best possible service for both our products and our customers. To achieve this goal, we have expanded our range of repair and calibration services to provide more solutions and flexibility for our customers.

Every service is designed to meet a different level of product support, whether it's a single unscheduled repair or a five-year Service Agreement that meets MIL-STD-45662.

Service Warranty

Fluke warrants products it services and parts it sells to be free from defects in material and workmanship for the period given below:

(1) product repaired under Standard Price Program for 90 days from shipment of repaired product.

(2) product repaired under Extended Warranty Plan for the period of the extended warranty.

(3) product repaired under Labor and Materials Services for 90 days from installation, replacement parts installed under OnSite Repair Program for 90 days, and labor under OnSite Program for 14 days.

(4) service parts for 90 days from date of shipment.

This warranty applies if you are the original purchaser. It does not apply to fuses, disposable batteries, or any product or part which has been misused, altered or damaged by accident or abnormal conditions of operation.

For warranty service, contact your nearest Fluke Technical Center for shipping instructions. If the product is returned to the Technical Center, it should be shipped freight prepaid.

Fluke will, at its option, repair your product or provide a module exchange free of charge. However, if Fluke determines that the failure was caused by misuse, alteration, accident or abnormal conditions of operation, you will be billed for the repair. After repair, we will return the product, freight prepaid.

THE WARRANTY STATED ABOVE IS YOUR SOLE AND EXCLUSIVE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OR MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.

NEW Full Coverage Service Agreements

- Comprehensive coverage for Fluke, Philips and for mixed instrument types
- Flexible Service Agreements that meet your total installed test and measurement instrument needs
- Most cost-effective service
- Large volume and multi-year discounts
- Handle all your service needs with one simple plan

The traditional high quality service you expect on your Fluke and Philips instrumentation is now available on your other test and measurement equipment. Call us to tailor a Full Coverage Service Agreement for your workload and reduce your costs, with Fluke quality!

You can reduce your costs substantially with Service Agreements. But you'll save more than money — you'll also save paperwork and administration time. An Agreement is based on the total cost of your yearly services.

It's as easy as this. Contact your local Fluke Sales Representative or your nearest Technical Center Manager and discuss your product mix and yearly requirements. We will develop a quotation for a Service Agreement for your review and consideration. We can even customize a plan that precisely fits your needs.

The dollar volume can include any mix of products on any service plan. You cannot, however, combine Extended Warranty discounts with Service Agreement discounts.

The manager of your nearest Technical Center will determine the mix of Fluke services that gives you the greatest discount. Call today and learn exactly how much you can save this year.

O.E.M. Services

If you are an O.E.M. customer for Fluke and Philips products, we also have repair and calibration services to meet your needs. Because your business needs require special support, we suggest you contact your local Fluke Sales Representative. Once we know your needs, we can tailor a service plan that supports your business.

Extended Warranty Service

- Fixed maintenance cost so you can budget accurately each year
- Prioritized service
- Shorter repair cycle
- Reduced parts inventory
- Lower maintenance training costs
- Less demand on your technical personnel and resources
- All parts are covered, including CRTs

Fluke and Philips' Extended Warranty Plan provides your equipment the ultimate protection at one economical price. Comprehensive agreements provide routine calibration at regular intervals or repair service as needed. Or, you can combine these options for full service coverage.

NEW Extended Warranty Performance Verification Plan

This plan is the same as Calibration except that only those specific values found to be beyond 70% of their rated accuracy specification will be adjusted. We verify your instrument according to detailed performance procedures. The instrument will be given a verification label and you will be notified of any out of tolerance conditions for traceability. This plan saves you money over calibration, plus gives you faster turnaround time. This is available on-site as well.

Extended Warranty Calibration Plan

Trust the scheduled calibration of your Fluke instruments to the world's leading manufacturer of calibration instrumentation and standards. Under this plan, we'll calibrate your instruments at the Fluke and Philips recommended intervals. In accordance with our extensive calibration procedures. You'll automatically receive a 30-day advance notice that your instrument is due for calibration. If your instrument's application requires a different calibration interval than normally recommended, we can tailor a plan to meet your needs. Either way, you can expect priority service and turnaround.

We'll return the instrument with a Certificate of Calibration for your records. Should you need more documentation to meet MIL-Standards we can easily include detailed Calibration Reports as part of this plan for a nominal charge.

Extended Warranty Complete Repair Plan

This plan is an extension to your product's warranty. Whenever your product needs repair service, simply send it to the nearest Fluke and Philips Technical Center. There, it is repaired, recalibrated, and performance tested — with priority scheduling. All parts and labor are included in the price of this service, even parts that are normally excluded from the Standard Price Service plan. So there won't be any surprises, even return surface freight costs are included. As you might expect, a Fluke Service Report and Certificate of Calibration is enclosed with each repaired instrument. Contact the nearest Fluke and Philips Technical Center for complete terms of the extended warranty.

Extended Warranty Full Service Plan

If you need both scheduled calibration and periodic repair service, there is no better maintenance program for your Fluke and Philips equipment than our full service plan. We've combined all the features of the Extended Warranty Calibration and Extended Warranty Complete Repair into one full service plan at a discount. You pay a reasonable fee for each instrument, eliminating most additional service expenses.

Plan Ahead and Save

We offer a 10% discount on the listed price of all extended warranty plans when you purchase the agreement at the time of instrument purchase. Even if you purchase this service prior to the expiration of the product warranty, we'll discount your plan by 10%.

You can also reduce your maintenance expenses with a Service Agreement. This agreement is based on the total dollar amount of your Extended Warranty or other service plans.

Pre-plan Inspections

Sometimes an instrument inspection is required before we can offer an Extended Warranty plan. This usually occurs when an instrument's warranty has expired. An inspection at a Fluke Technical Center is free or you can pay a minimal fee for an inspection at your site. If the condition of your instrument precludes coverage, we'll provide a Labor and Materials Service quote for the repairs necessary to qualify your instrument.

Blanket Purchase Order

- Reduced paper work
- Less administrative time
- Discounts

Open a purchase order with Fluke, thus making your calibration and repair work easy, but still on a per-incident basis and we will give you a 10% discount off the standard price.

Standard Price Service

- One-time repair or calibration at a fixed price
- Added support for your own maintenance program
- Take advantage of Fluke and Philips' expertise and resources on an as-needed basis

These cost-effective services can be used to repair or calibrate your Fluke and Philips equipment on a one-time basis. For customers who routinely service their own instruments, this service offers an easy way to smooth out your peak workloads. For others, it's an easy and economical way to take advantage of Fluke's extensive service.

The Standard Price Service Program establishes a fixed charge for calibration and/or repair for each type of instrument. The price for calibration and/or repair includes labor and most material required. Exception parts are noted in the price list.

These standard prices, which are based on historical averages for time and material, help you determine service costs in advance and avoid the potentially critical delay of quotation approval procedures. Naturally, some units may have to be excluded from the program because of age or abuse. In such cases you will be advised and, if you approve, charged on the basis of the actual labor and parts required.

NEW Standard Price Performance Verification

Same as the Extended Warranty Performance Verification, but for one time, non-agreement service, based on a fixed, budgetable price.

Standard Price Calibration

Routine calibration ensures your product is performing to published specification. Every instrument calibration follows the procedures specified in our maintenance manuals. Instruments are then returned with a Fluke Certificate of Calibration, your proof of traceability to the National Bureau of Standards. In addition, we also include calibration labels to indicate the date of calibration and the date of next calibration, as well as tamper-proof seals to protect the integrity of the calibration performed.

Standard Price Full Service

This is a cost-effective way to service your Fluke and Philips product on a one-time basis. Using the industry's finest test equipment, our factory-trained technicians will test all functions and ranges while making the required repairs. We replace any defective parts with Fluke and Philips specified and tested parts to ensure the repaired instrument performs to manufacturer's published specifications.

During repair, we will also install product changes that enhance the instrument performance and reliability. Then, it is calibrated in the same mannner as in the Standard Price Optimized Calibration service, complete with the same certification, labels and seals. Each unit is completely performance tested and returned with a service report.

Calibration & Repair

Warranty

Standard Price repairs carry a complete instrument warranty for 90 days. This warranty covers the entire instrument, not just the portion that was repaired. (Storage CRTs are excluded unless replaced during the repair. All CRTs over 7 years old are also excluded.) This is the best warranty in the industry.

A Fluke Calibration Warranty guarantees your instrument's calibration for 90 days after it's returned to you. Even if the product fails, you pay only the repair charge and recalibration is provided at no charge.

NEW Emergency 48-Hour Service

When an instrument fails and downtime is costing you hundreds of thousands of dollars, use our emergency 48-hour service. From the time your instrument arrives at a Fluke Technical Center to the moment we ship it back to you, it receives first-priority access to parts, labor and equipment in the service lab.

This 48-hour service is available for a rush charge of $100 for calibration and, $200 for repair in addition to the standard repair price. (except for Handheld Multimeters and Digital Thermometers: Calibration & Repair for $25). If for any reason we cannot meet the 48-hour commitment, you will be notified immediately and, of course, charged only the standard service fee. Call your nearest Fluke Technical Center for immediate help.

Labor and Materials Service

- Instruments that are out-of-production and no longer included on the standard price list
- Instruments that have been seriously damaged
- Instruments that have been exposed to unusual conditions or harsh environments
- Products that have special modifications
- For any special service requirements.

Sometimes you may want or need a firm price quotation of labor and material repair. Using this service, you'll know exactly the cost to get your instrument repaired. And, to keep you on schedule, this firm quote is valid for 30 days and also includes an estimated turnaround time for repair.

Discontinued Products

We stand behind each Fluke and Philips product for its full life cycle. This means we'll service instruments manufactured more than 20 years ago or even those we discontinued. These repairs, however, are handled case-by-case because of the availability of certain parts.

Pre-plan Qualification

If you would like to take advantage of our Extended Warranty plan, but your instrument does not pass the inspection, you can count on the Labor and Materials plan to get your equipment qualified. We'll always give you an estimate of the necessary repairs, whatever the reason for failure.

Modified Products

If you have a Fluke or Philips modified or special product, it may require an additional charge to qualify for the Standard Price Service or Extended Warranty plan. To find out if this applies to your special equipment, call your Fluke or Philips Technical Center.

Warranty

Instruments repaired under Labor and Materials Service are warranted to be free from defects in material and workmanship for 90 days. This applies to the entire instrument, not just the repaired portion, which is unique in the industry.

Service Methods

- Fluke Technical Center
- Pick up and delivery
- On-site
- International and Philips Service Centers in selected countries

Fluke Technical Center Service

- Quick turnaround
- Local or regional proximity to your business

Instruments are typically portable. So when your instrument requires calibration or repair ship it to us and we will service it and return it. Return shipping is free under service agreements and extended warranty plans.

NEW Pick Up and Delivery Service

- Eliminate your shipping paperwork and costs
- Reduce downtime

If you have many instruments requiring service and are within selected service regions a van can be dispatched to you for this service. Request this time saver today.

On-Site Service

- Performance Verification
- Minimize downtime
- Guaranteed response time
- Preventive maintenance
- Custom agreements
- System Service

Most systems you buy from Fluke include a 90-day on-site warranty. Under this warranty coverage, we'll repair your system on-site in the event it fails. After this 90-day period, each instrument in the system continues to be covered by the Fluke standard warranty. The instrument service would then be performed at one of our Technical Centers.

If you would like to continue on-site service after the 90-day on-site warranty period, you can request a Supplemental On-Site Service Agreement. The instruments that are commonly used in systems can be covered by Supplemental On-Site Service. This eliminates the need to remove the instrument from the system and send it to a Fluke Technical Center for warranty service. The fee is nominal, just the extra expense of on-site service from the Fluke Technical Center to your facility.

After the warranty period and the Supplemental On-Site Service coverage, you can continue on-site service by using our Basic On-Site Service. Also you can now have your instruments verified within an accuracy range or repaired when necessary on-site, with our On-Site Performance Verification offering.

International and Philips Service Centers

- Worldwide support
- Multinational corporation assistance

Fluke and it's affiliates are trained and equipped to meet your needs in most countries around the world.

Value-Added Services

- No charge
  - -90 Day "Full Instrument" Warranty, including CRTs
  - -Service Reports
  - -Calibration Certification & Instrument Labels

Not only do you get the best warranty in the industry, but you can also receive free service reports, calibration certificates and labels.

Service Reports

When your instrument is repaired by a Fluke Technical Center you automatically receive a Service Report for any work performed.

Calibration Certificates & Labels

For every product calibrated, Fluke includes a Certificate of Calibration. It's your guarantee that the instrument meets its specifications and is traceable to the NIST (NBS). Any instrument calibrated by a Fluke Technical Center will be returned with a calibration label indicating the date of calibration and the date of next calibration. We'll also affix tamper-resistant seals to your instrument.

Options

- Automatic upgrades
- Calibration documentation
- MIL-STD-45662 service

Automatic Upgrades

When you return your instrument to a Fluke Technical Center, the professional technicians will upgrade your instrument to the latest revision, thus improving your performance.

Calibration Reports

If you need more detailed reports for MIL-STD-45662 or in-house quality assurance programs, we can provide comprehensive calibration reports. This includes the actual readings taken from each range and function of an instrument.

MIL-STD-45662 Calibrations

If you require calibration that meets MIL-STD-45662 we can provide this service and the documentation. Full compliance with 45662 includes the following items:

- Formal calibration procedures with recording of test results before and after any necessary adjustments.
- Records of calibration dates and identification of calibration standards and technicians.
- Records of accuracy of test standard's accuracy and controlled environmental conditions.
- System of notification and recalibration when test standards are found to be out-of-tolerance.

Self-Maintenance Programs

- Several customer-oriented programs for doing your own calibration and repair

Service Parts

- Components that meet Fluke and Philips specifications standards
- Automatic supply of improved replacement types
- 90-day warranty
- Toll free parts order line (800) 526-4731
- Recommended spare parts and module kits

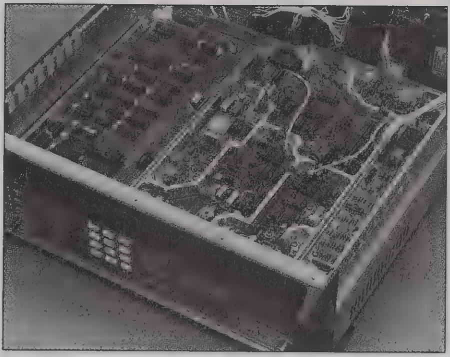
Availability of replacement parts is a key element in providing quick turn-around and product support for customers who perform their own maintenance. By providing quality parts and responsive support, Customer Support Services will help return your Fluke or Philips products to peak performance.

To support this service, an extensive inventory of repair parts is maintained by the Service Parts Center located in Everett, Washington. This computerized center stocks several hundred thousand components, subassemblies, and modules that are listed on a microfiche catalog. All replacement parts are warranted against defects in materials and workmanship for 90 days after shipment. From most U.S. locations, you may place your orders directly to the Service Parts Center by calling our toll-free number, (800) 526-4731. From Alaska, Hawaii, or Washington call (206) 356-5774. You may also order by Telex # 185249 or FAX (206) 356-6331. From locations outside the U.S., place your parts order with your nearest International Representative, who will expedite processing or fill your order from local inventory.

When ordering, please identify parts by the Fluke 6-digit or Philips 12-digit part number and description as shown in the instrument manual and, if possible, by the schematic diagram circuit reference number. The model number and serial number of the instrument will also help us supply the correct parts.

In some cases parts must be ordered in matched sets in order to maintain the specified accuracy and performance of the instrument after repair. Check the parts list and diagrams for footnotes which contain the instructions for ordering special parts.

Recommended Spare Parts Lists and Spare Parts Kits, and instrument manuals are also available for most Fluke or Philips products.



Module Exchange Program

- Available for most modular products
- 48-hour delivery to most U.S. locations
- Minimum downtime for critical applications
- Reduced maintenance personnel training requirements
- Takes full advantage of product diagnostics
- 90-day warranty
- Toll Free Order Line (800) 526-4731 or Telex # 185249, FAX (206) 356-6331

Many Fluke instruments are modular in design and can be serviced most effectively by exchanging a defective module.

The Module Exchange Program allows you to obtain an exchange module quickly and economically. When using this program, you need only identify the defective module, which simplifies your troubleshooting procedures and reduces your training and skill requirements for maintenance personnel. Self-diagnostics built into many Fluke instruments further simplify the process of identifying the faulty module.

Once an out-of-warranty, defective module is identified, you can place your order with the Module Exchange Center located in Everett, Washington by calling our toll free number (800) 526-4731. From Alaska, Hawaii or Washington call (206) 356-5774. The replacement module will be sent directly to you via overnight air carrier. You will also receive return shipping instructions for the defective module, which must be returned to avoid charges. A similar program is offered to customers in countries outside the U.S.

Please contact the Fluke Module Exchange Center or International Representative for a list of Fluke products which are supported by the Module Exchange Program, and detailed information on exchanging defective modules.

Recommended Spare Parts Kits

Based on product lifecycle data, our Service Engineering group has recommended an optimal list of replacement parts required to ensure maximum instrument uptime. These kits are available for most current products. If you have an instrument in a remote location or if maximum uptime is a priority in your specific operation, please call our Service Parts Center for a kit to support your particular model.

NEW Upgrade/Service Kits

You can keep your instruments up-to-date yourself with specially kitted upgrades. These kits both improve performance or increase reliability. Also, a unique **Surface Mount Device Service Kit** is available to repair your state-of-the-art instrumentation. Included with this kit is all the tools and accessories required, as well as a video-based training package. Call the Fluke Service Parts Center in Everett.

Operator and Service Manuals

Documentation is the mainstay of the technician. They are obtainable through the Service Parts Center.

NEW Provisioning

Do you need a full range of provisioning services? Fluke has a service for you that meets your specifications or those of military standards 1552A/1552B today.

NEW Microfiche Program

If you repair or calibrate Fluke instruments and want to take advantage of the latest product improvements, our Product Change Notice Subscription Service on microfiche is for you. This service offers a complete collection of notices describing product changes, reliability improvements, upgrade kits, and safety modifications.

Complete information is provided to allow you to modify and update your instruments. Notices include the reason for the recommended modification, technical instructions, drawings, and parts list.

The base set comes in a binder containing 35 fiche which hold over 2200 Change Notices. More than 350 Fluke products are included — from handheld multimeters to board test systems. An index card, sorted by model number, lists each Change Notice and a brief description of the change. A microfiche reader with a 24X lens is recommended for best viewing.

Included free with the base set are Fluke's Service Parts catalog and Customer Support Services literature. Together, this set makes a valuable reference for those who perform in-house maintenance of Fluke equipment.

To keep your base set up to date, order the annual subscription service. New and revised Change Notice fiche are mailed in January, May, and September. You'll receive a renewal notice near the end of the subscription period as a reminder to reorder for the coming year.

Product Change Notice Base Set
Complete collection plus two updates to provide coverage for one year.
Fluke P/N 847777 $295 U.S. List Price

Product Change Notice Subscription
Mailed in January, May, and September.
Fluke P/N 847780 $150 per year

System Integration

Systems Support/Solution

- Measurement & Test System Consulting
- Hardware Configuration
- Software Design and Development
- Project Coordination
- Installation Support
- Authorized Third Party Support through Fluke Cooperative Services
- Turnkey Projects

When Fluke and Philips electronic test and measurement equipment is used in a systems application users often require additional support from Fluke. The Fluke Systems Integration Group provides a wide range of services from consulting and start-up assistance to hardware and on-site software development. We will make sure your project gets on track quickly, and stays on track.

The Fluke Systems Integration Group can provide support tailored expressly for your application. Whether you need complete turnkey solutions or additional manpower to augment your in-house programming staff, Fluke has the solution.

Fluke's Systems Integration Group has a team of designers and Fluke Cooperative Service (FCS) partners ready to assist you with your systems integration needs. When you take advantage of Fluke's expertise you can be confident that your system design will reflect the latest technology configured to match your application.

Our services are designed to support a wide variety of customers from first-time users of Fluke and Philips equipment to customers creating advanced systems on accelerated implementation schedules. When you plan to implement an instrument system, count on our Systems Integration Group and FCS for help. No one knows test and measurement like Fluke and Philips. At Fluke we can custom tailor a solution specifically for your application.

Extensive System Testing

Prior to arrival, Fluke systems are tested for functionality both before and after a system burn-in period of 96 hours. These tests are over and above our extensive, standard tests for the individual system instruments. On arrival, Fluke performs a system installation, verifies system operation and reviews operating procedures with your personnel.

Complete System Service

Confidence in your system extends beyond the value of the system itself. You have system expandability to meet your future needs. In addition to supplying quality hardware and software, Fluke provides training and 90 day on-site service as part of the total package.

Documentation

Our instruments and systems include full documentation. Fluke systems include instrument operator and service manuals, system manuals and drawings. Fluke also makes available other references, including Technical Data Bulletins, applications notes, technical papers and service information.

Ask your Fluke Sales Representative about the many successful system projects.

Fluke Cooperative Services

- Independent specialists
- Specific industry expertise
- Team resources for large projects

Fluke's Cooperative Services program may be the answer to your test, measurement, or control application.

Today's projects require integration of hardware, software, training, and support to arrive at a total solution — on time and within budget. Today's projects call for teamwork. That's why we formed Fluke Cooperative Services (FCS).

The Fluke Cooperative Services team is a network of independent specialists who know hardware, who know software, and who know your industry.

With Fluke and FCS, there's no more shopping around and no more unclear accountability.

We carefully selected FCS members because of their expertise and because they are team players. We've already worked together, so we're ready to go to work for you on your project.

Teamwork and FCS — put them to work for you. You'll have one team to work with and one team that will stand behind its promises. We think that's better than passing the buck.

Fluke will always ascertain whether an FCS partner will ensure a successful solution, especially when your application is in a vertical market that fits the FCS's expertise, and the FCS has the expertise to provide a complete solution.

Software Programming

- Data Acquisition
- Board Test
- Measurement

Fluke will analyze your test, measurement or control requirements. Then we will propose the best approach for you to get your programmable instruments or system operational.

Your solution may be:
- an instrument "programming" training course
- consulting to establish a software design for your software engineers
- a complete turnkey project delivering your software on time and within budget, based on an agreed to system software description and proposal.

Fixturing

- Value-Added Board Test
- Specifications/Recommendations

Fluke has researched and evaluated several third party vendors of test fixtures for ATE and testers like the 9100 Digital Test System, and offer these authorized, independent fixturing/programming houses in the Fluke Cooperative Services (FCS) program.

If you want to extend your automation through fixturing — card edge, bed-of-nails, autoprobing, or custom — you can feel confident the job will be done well with an FCS partner who specializes in your industry.

Installation Services

- Integration/Start Up
- "Getting Started" Support
- On-site training
- On-site service agreements

Installation of your system is performed by a Fluke Service Engineer from the nearest Fluke Technical Center. The Technical Center will call you in advance to discuss site preparation and to schedule the installation.

When your system arrives and the Technical Center has been notified, the Fluke Service Engineer will travel to your installation site for the actual installation. Installation takes typically one day and consists of the following steps:

1. Uncrating the system and checking for any shipping damage.
2. Verifying the contents of the shipment against the packing list.
3. Assembling and powering up the system.
4. Running the Self-Test Software. A Self-Test software procedure is supplied either embedded in the system software or on a separate diskette with the system. This software enables the operator to test each of the instruments in the system through a series of functional evaluations.
5. Familiarizing your personnel with System documentation which includes explaining the purpose of each manual and each floppy disk.

System Integration

6. Familiarizing your personnel with System operation. Formal software training is also available upon request.
7. Performing the customer acceptance sign-off, which means, your representative will sign both the acceptance letter and the Field Service Report.
8. Presenting our Customer Support Package, explaining who to contact for service, service agreements, training and systems assistance.

System Components

- Data Acquisition Multifunction Board for Fluke 1752 or 1711A/AA
- 9000/9100 Series Pod Adapters

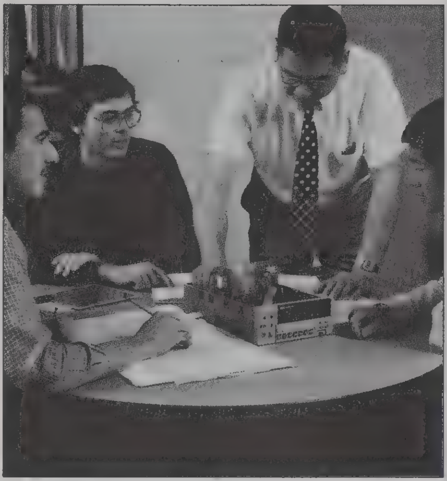
Throughout Fluke's history of creating systems, several product enhancements have been developed. They are available at a reasonable cost to help your systems come together both better and faster.

The multifunction boards' standard features include:

- Multitasking Commands for "stand-alone" processing power, allows the Fluke 1752 or 1711A/AA to concentrate on supervisory tasks, report generation and operator interface.
- 20 kHz Sampling of 8 differential analog inputs to characterize or react to rapid events.
- Store 27,000 Readings so the Multifunction Board can scan at high speed without constant attention of the user program.
- Continuous Control with 4 Analog Output channels, allows you to "close the loop" without adding options.
- 16 Digital Outputs for parallel output, "On-Off" control or device actuation.
- 32 Digital Inputs for status sensing or parallel input.

Inquire of your Fluke Sales Representative about additional features and capabilities.

Microprocessor specific interface pods can be custom built for your unique processor. Even though the 9000/9100 Series have the most extensive pod support in the industry, your microprocessor may not be covered. Several have already been built for the 8097 family, Z8, 6801/AA, 6803, and 3870, all for customers unique circuit boards. If you want a custom pod adapter, call your Fluke Sales Representative and provide us a schematic and working circuit board, for a quote today.



How to get Help

Your Fluke Sales Representative can discuss with you your system requirements. He can put you in contact with an extensive group of specialized sales people who will help you technically define your system requirements. Then a Fluke CSS Project Manager can coordinate a team of Customer Support Engineers and/or FCS partners to complete your project successfully.

To get a system, the above team will discuss with you a system specification, from which a proposal and quote is developed. If the parameters and job description are agreed upon, engineering status reports are set up to keep you informed of the project progress along with an integration plan and delivery schedule.

When you plan to implement a complex Fluke instrument system, count on our System Integration Group for help. We offer professional consultation for both system software design and hardware configuration. We can help ensure your design decisions produce the most effective system for your equipment investment.

Our consulting service includes assistance with the overall design of a system as well as with coding and peripheral integration. We help you select the right Fluke instrument and show you how to expand and enhance your system with options and accessories.

Let Fluke help you maximize your system's capabilities. When you take advantage of Fluke's expertise you can be confident that your system design will reflect the latest technology configured to precisely match your application.

Call toll free (800) 443-5853, ext. 73 for information.

System Warranty

Notwithstanding any provision of any agreement the following warranty is exclusive:

The John Fluke Mfg. Co., Inc., warrants the system it manufactures to be free from defects in material and workmanship under normal use and service for the period of 90 days from date of installation. Software is warranted to operate in accordance with its programmed instructions on appropriate Fluke Systems; it is not warranted to be error free. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, flexible disks or contents thereof, or any product or part which has been subject to misuse, neglect, accident or abnormal conditions of operations or handling.

In the event of a failure covered by this warranty, the John Fluke Mfg. Co., Inc. will repair the system on-site within 90 days from date of installation; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the system in lieu of repair. With regard to any system repaired on-site within 90 days from the date of installation, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident or abnormal conditions or operations, repairs will be billed at a nominal service cost. In such case, an estimate will be submitted before work is started if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS OR ADEQUACY FOR ANY PARTICULAR PURPOSE OF USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.

Customer Training

Customer Training
- Product Applications Courses
- General Technology Workshops
- Maintenance Training
- Special customer training packages

Training Pays Off In Productivity

Fluke Customer Support Services is dedicated to providing information, assistance, and training for people who use and maintain Fluke and Philips products. As a designer and manufacturer of sophisticated instrumentation, we recognize that well trained technical people are an asset which is essential to productivity.

To gain maximum performance and productivity from your Fluke and Philips equipment, spend just a few days training with our experts. Our Product Applications Courses, General Technology Workshops and Maintenance Training courses combine comprehensive lectures with hands-on experience that will provide a sound understanding of both our equipment and documentation.

Product Application Training

Whether you've just purchased Fluke products or you already own them, our Applications Training will help you to enhance their effectiveness by taking advantage of every advanced feature.

1722/1752 Applications
2452 Applications
7411 Procedure Writing
NEW 900 Dynamic Troubleshooting
9010 Troubleshooting
9010 Programming
9100 Applications
9100 Programming
FlexSys Software
70 Series Solutions (self-paced course including workbooks or video-based course with instructor manual and overheads)

General Technology Workshops

The Fluke company is recognized as a leader in the test and measurement industry. The General Technology Workshops are designed to share our expertise in design, manufacturing, service and calibration. You will not only gain an understanding into the application of specific Fluke and Philips equipment but also explore concepts and ideas through the use of interactive hands-on exercise.

Principles of Metrology
NEW Calibration Lab Management
NEW Atlas Programming
NEW Principles of Microprocessor Systems
NEW Principles of Logic Analyzers
NEW Principles of Analog Scopes
NEW Principles of Digital Scopes

Maintenance Training

If you repair your own equipment, our Maintenance Training courses give you the opportunity to learn about the technology behind the features and functions, and help you to effectively troubleshoot and maintain even the most complex systems. These classes are unscheduled. Call to set up a class.

1722 Maintenance
2280 Maintenance
3040/50 Maintenance
3200 Maintenance
5100 Maintenance
5200 Maintenance
5205 Maintenance
8000 Maintenance
8500 Maintenance
8840 Maintenance

Free Training Certificate Program

When you purchase the following Fluke products, you are entitled to receive one special certificate to attend a related Product Application Course. The certificate allows you, as a Fluke customer, to waive the tuition*. This special program ensures that you get the most out of your purchase. Ask your Fluke Sales Representative for your certificate today or call 1 (800) 443-5853 ext. 73 for help.

Product	**Course**
900	900 Dynamic Troubleshooting
9005/9010A/ 9020A	9010 Board Tester Troubleshooting
9100A	9100 Board Tester Applications
9100-004/ 9100-005	9100 Board Tester Programming
9100A/SYS	Both 9100 Board Tester Troubleshooting and Programming
1790A-400/ 1790A-500	FlexSys Software Programming
A123	7411 Calibration Systems Software Applications

**Only one certificate per instrument/system purchased.*

Schedule

We schedule our courses throughout the United States and Canada for your convenience. Dates, fees and locations are shown in The Fluke 1989 Course Planner available from your Fluke Sales Representative.

Your Fluke Sales Representative can also provide data sheets with detailed course descriptions, outlines and prerequisites. We recognize that our scheduled classes may not fit your needs or schedule. That's why we offer On-Site and Unscheduled Training.

On-Site Training

If our scheduled courses are not convenient or you want to train a larger group of people, an on-site course is an easy, economical solution at your location.

Unscheduled Training

Unscheduled training courses for up to ten of your people can also be given at one of the designated Fluke training facilities.

For more information on unscheduled training and on-site training contact one of the Training Coordinators.

At Fluke we believe that our customers purchase more than just a piece of test equipment. We are committed to providing solutions that meet your requirements. **To order call toll free 1 (800) 443-5853, ext. 73.**

Training Coordinators

Irvine, CA (714) 863-9031
Chicago, IL (312) 705-0500
Paramus, NJ (201) 599-9500
Toronto, ONT Canada (416) 890-7600

Product Application Courses

1722/1752 Instrument Controller

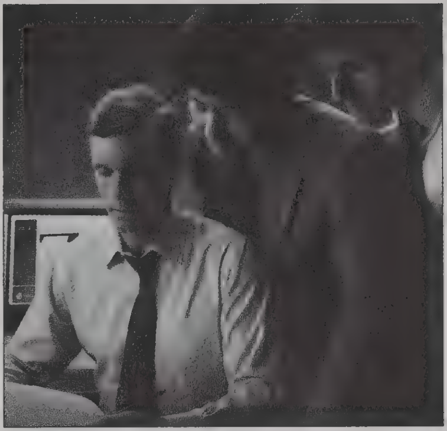
Software and Applications

Course Objectives: This Applications Training course will detail the 1722's approach to controlling system operations through skills gained in software programming and hardware configuration of the unit. With an understanding of the standard hardware components, available options, and the configurations of those options, you'll gain insights to your particular application needs. The software training includes complete coverage of FDOS (Fluke Disk Operating System), System Utility Programs, and Fluke Extended BASIC, all of which are available to the user. Graphic capabilities, Menu creation, and Touch Sensitive Overlay software commands are detailed and explored.
Prerequisites: You should be familiar with the BASIC programming language and the operation of measurement/sensor types of equipment (i.e., thermocouples, transducers, thermistors, RTDs). Knowing another programming language would be beneficial, but is not mandatory. A background in electronics would be helpful, but not necessary.
Who Should Attend: Operators, programmers, managers, and supervisors who have a need to operate, program, or interface the 1722/1752 Instrument Controller to their particular application.
Course No. 1722TAF/5 Days $1250

2452 Measurement Control System

Software and Applications

The 2452 Measurement Control System is one which combines a 2400B Intelligent Front End Computer and either a 1722A or a 1752A Instrument Controller. When linked together and configured to the particular application, the 2452MCS is a powerful measurement, data acquisition, and control system.
Course Objectives: This intensive 5-day course will cover the utilities, graphics, hardware configurations, program development, and various customer applications of this system as they relate to data acquisition and controlling tasks. During the first three days the utilities of the 1722A/1752A will be detailed. The remaining two days will deal with the 2400B, its various configurations, and machine control language.



Prerequisites: You should be familar with the BASIC programming language and the operation of measurement/sensor types of equipment (i.e., thermocouples, transducers, thermistors, RTDs). Knowing another programming language would be beneficial, but is not mandatory. A background in electronics would be helpful, but not necessary.
Who Should Attend: Technicians, engineers and managers who have a need to operate, program, or interface the 2452 to their particular application.
Course No. 2452TAF/5 Days $1250

7411 Calibration Systems Software

Applications

Course Objectives: While attending this five day course you will become familiar with the 1722A Controller Hardware and System Software. You will learn how to configure, install and use the 7411B Software Set. You will develop Performance Tests and Calibration Procedures, effectively using the equipment that is normally installed in your system. "Closed Loop" calibration techniques will be examined including techniques that may be used to insure operator safety and testing accuracy. Calibration History Management will be discussed including the options available for dealing with same.
Prerequisites: You should have an elementary understanding of calibration practical applications and practices. Computer and/or ATE system experience is not required. A working knowledge of your company's policies and practices in calibration would be beneficial but not absolutely necessary.
Who Should Attend: All professionals who are involved in the everyday programming and control of the 7411A/B Software installed in a 7404A, 7405A, 7409A, 7410A, 7449A or, an A123 Custom Calibration System.
Course No. 7411TAF/5 Days $1250

NEW 900 Dynamic Troubleshooting

Course Objectives: In this two day introductory course the student will learn the principles of operation, sequence programming, and troubleshooting with the Fluke 900 Dynamic Troubleshooter. They will learn to use the various features and functions of the 900 including Dynamic Reference Comparison, setting Performance Envelopes, and Sequencing.
Prerequisites: None.
Who Should Attend: Design engineers, manufacturing test engineers, and anyone responsible for troubleshooting and/or repairing microcomputer circuits.
Course No. 900TGF/2 days $495

9010 Board Tester

Troubleshooting

This course was designed to provide your personnel with the problem solving methodology needed to stay current in today's microcomputer technology. Whether you're doing service repair, assembly line pre-testing, or debugging newly designed circuits still on the breadboard, you'll find this course extremely useful when dealing with complex microcomputer circuits. By being able to quickly and methodically troubleshoot to the component level you'll see confidence and productivity rise and costs fall.
Course Objectives: In this two day course you will learn to use the 9010A to troubleshoot to the component level using actual microcomputer boards. Using the built in tests and error messages, you will apply the 9000 Series Troubleshooting Strategy to isolate actual hardware problems in a hands-on environment. Testing of I/O LSI devices and the use of the Asynchronous Signature Probe option are heavily emphasized.
Prerequisites: An understanding in the basic operation of microprocessor bus structured circuitry.
Who Should Attend: Design engineers, manufacturing test engineers, test/repair technicians, service engineers and anyone responsible for troubleshooting and/or repairing microcomputer circuits.
Course No. T9000TAF/2 Days $495

9010 Board Tester

Programming

Course Objectives: This course will stress programming techniques that will make using the 9010A both easier and faster. You will participate in the development and testing of Utility Programs, which will be used as the building blocks toward a full functional test. Included in the course will be a review of troubleshooting operations, hands-on circuit experience, and actual applications aimed at testing and troubleshooting I/O devices.
Who Should Attend: Design engineers, manu-

facturing test engineers, service engineers.
Course No. T9001TAF/2 Days $495

9100 Board Tester
Applications

Course Objectives: In this two day intensive hands-on training class the student will learn to develop a systematic approach to test strategy development using the 9100 immediate mode of operation. Specifically the student will use emulative testing to functionally test digital circuits. They will learn to recognize circuit failures using built-in diagnostics, signature analysis, level detection, frequency and overdriving techniques.
Prerequisites: An understanding in the basic operation of microprocessor bus structured circuitry.
Who Should Attend: Design engineers, manufacturing engineers, service engineers.
Course No. 9101TAF/2 Days $495

9100 Board Tester
Programming

Course Objectives: In this five-day intensive hands-on training class the student will learn to develop a systematic approach to test strategy development using the 9100 programming environment. Specifically the student will use the 9100 editor to develop programs designed for fault isolation and functional test. They will develop all of the data base elements and perform fully automated guided fault isolation, simple GO/NO-GO functional test, and full diagnostic software enhancing the efficiency of the 9100 backtracing algorithm. The student will develop models for fault isolation programs and fault handling diagnostics that will apply directly to their UUT applications.
Prerequisites: Completion of the 9100 Applications Introduction or 9010 Troubleshooting course. The student should also have experience in a higher level language such as: Pascal, C, or Basic.
Who Should Attend: Design engineers, manufacturing engineers, service engineers.
Course No. 9100TAF/5 Days $1250

FlexSys
Software Programming

This ten-day course studies the advantages of the FlexSys ATE Workstation environment over the present ATLAS development systems by learning the functions of each of the components of the FlexSys System.
Course Objectives: The course discusses the software development environments and the execution of ATLAS/FlexSys procedures on a working ATE system. Emphasis is placed on hands-on program development and will cover the structure and syntax of:
- ATLAS/FlexSys language
- Resource Description language and formation of the RD library
- Assignment Files
- Configuration of the ATE system
- Linking of non-ATLAS procedures to the ATLAS procedures
- Summary file

Prerequisites: The course is very programming intensive. Approximately 40% of the class time is used for procedure writing and programming tasks. Because of this the student should have knowledge or experience with programming. Additionally, the student must have a working knowledge of Automated Test Equipment and how to design an ATE procedure using a programming language. The student must also have a working knowledge of standard computer utilities such as file transfer, display editors, file management, compilation routines, and I/O device management. Although it is not necessary, the student would be more comfortable if he had a basic familiarity of the ATLAS language, since FlexSys is an implementation of Common ATLAS. It would also be beneficial if the student had experience in the remote programming of digital multimeters, instrument controllers, power supplies, and analog system integrators.
Who Should Attend: The FlexSys course is useful to test and programming engineers and technicians who are familiar with IEEE remote controlled test instrumentation configurations and who have a need to develop ATLAS compatible procedures for government submission.
Course No. 1790-TGF/10 Days $2500

70 Series Solutions

This is a unique course that user's or schools can utilize to train themselves on Fluke's most popular digital multimeter, and gain knowledge in basic DMM technology.
- Student workbook sets
- Instructor manual and overheads
- Video tape

The Fluke 70 Series Training Package, explains how to use a multimeter to measure voltage, current and resistance as check diodes and transistors. This course covers the questions of "why" as well as explaining "how". Why can a current meter damage a circuit under test? Why doesn't the measured value of an in-circuit resistor match the value of the resistor's color code? Why do some voltages produce readings on both the ac and dc voltage functions of a multimeter? Understanding the "whys" of multimeters will aid you in interpreting measurements and test results from electronic circuits.

Anyone with a basic understanding of electronics can use this self-paced and instructor run course for training on the 70 Series Multimeters. The explanations given assume that you have the knowledge of the following concepts:
- Ohms Law: The relationship between voltage, current, and resistance.
- Parallel Resistance: Total resistance decreases as more parallel branches are added.
- dc and ac: DC is direct current, which does not change in amplitude or direction. AC is alternating current, which changes in amplitude and direction over time.
- Shorts and Opens: A short has no resistance. An open has infinite resistance.
- Use of an Oscilloscope and signal Generator: Two of the Hands-On Training exercises involve the use of an oscilloscope and signal generator. These exercises can be omitted, if necessary. Or, one person who knows how to use the scope and generator can take charge of operating them.

You can use this textbook even if you have little experience in electronics. The textbook is suitable for anyone who uses or will be using a multimeter: students, electronic assemblers, technicians, automobile service persons, hobbyists, etc. Even if you have considerable experience with electronics you may learn something new. It's surprising how many people working in the electronics field aren't sure how to use a current meter properly or don't know how to use an ohmmeter to test a diode.

The total set costs $225 plus shipping & handling (Part Number 833004). You can buy separate pieces as well: Set of 25 student workbooks -$62.50 (Part Number 832998), video tape - $85 (Part Number 833244). Call the Fluke Service Parts Center at (800) 526-4731. From Alaska, Hawaii or Washington call (206) 356-5774.

General Technology Workshops

Principles of Metrology
General Technology

Course Objectives: Principles of Metrology is a one-week course covering electrical/electronic measurements and calibration. Participants will become more productive in calibrating test instrumentation. The course includes practical tips and exercises to illustrate:
- Loading Errors
- Lead Impedance
- Using Voltage Dividers
- Low Level Measurements
- Thermal EMFs
- Grounding and Guarding
- Measurement System Uncertainties

The student will also be introduced to "Creative Metrology." Creative Metrology is an innovative way of approaching the task of measurement from different points of view and extending the range of NIST (NBS) traceability. The kind of thinking and techniques required to extend measurement parameters are dealt with in detail. The student will begin to see and use creative techniques for their measurement and calibration requirement.
Prerequisites: None.
Who Should Attend: Engineers and technicians with an electronics background whose work involves measurements and calibration.
Course No. T1000TGF/5 Days $1250

NEW Calibration Lab Management

Course Objective: Students will learn the requirements of establishing and operating a calibration laboratory. Along with the requirements, they will acquire the tools which will help them

organize, develop, and arrange a laboratory from the entreprenurial point of view.
Prerequisites: None.
Who Should Attend: Managers and technicians involved in setting up a new cal lab for their company, or those presently involved in cal lab management but need some new ideas or a new perspective in solving particular problems in their existing operation.
Course No. 1005TGF/5 Days $1250

NEW Atlas 716 Programming

Course Objectives: This one-week course covers the IEEE standard 716 ATLAS language. Students will learn ATLAS program structure, syntax, and applications through lectures, audio-visual presentation, and hands-on laboratory exercises.
Prerequisites: The course is very programming intensive. Approximately 40% of the class time is used for procedure writing and programming tasks. Because of this the student should have knowledge or experience with programming. Additionally, the student must have a working knowledge of Atlas, Automated Test Equipment and how to design an ATE procedure using a programming language. The student must also have a working knowledge of standard computer utilities such as file transfer, display editors, file management, compilation routines, and I/O device management. It would also be beneficial if the student had experience in the remote programming of digital multimeters, instrument controllers, power supplies, and analog system integrators.
Who Should Attend: Programming engineers and technicians requiring a working knowledge of the IEEE-716 subset of the ATLAS language and who need to develop ATLAS test procedures for government submission.
Course No. 716TGF/5 Days $1100

NEW Principles of Microprocessor Systems

General Technology

Course Objectives: This is a two day course which covers the basic elements of microprocessor systems. Starting with discussions of the binary and hexadecimal numbering systems, the course continues on through bus descriptions, microprocessor operation, system timing, multiplexing, instruction sets, mnemonics, and opcodes. Students will learn to write programs in machine language, and will be completely familiarized with the architecture of a variety of different microprocessors. Hands on exercises involving the Fluke 90 and 9000 Series digital test equipment augment lecture topics.
Prerequisites: None. This two-day seminar is recommended as a precursor to Fluke's 900/9000/9100 Series Applications and Programming courses as well as being an introduction to microprocessor-based systems in general.
Who Should Attend: Engineers and technicians who are involved in the troubleshooting of microprocessor systems. Also, those who are involved in research and development who need to accelerate their learning curve to become more productive.
Course No. 1001TGF/2 Days $495

NEW Principles of Logic Analyzers

General Technology

Course Objectives: This course provides an excellent background in the operation and use of logic analyzers. Basic microprocessor theory is covered first, and then a program development system is used to write and run machine language programs written by the student. The results of these programs are monitored by a logic analyzer to learn both the nature of the programs, as well as the detailed operation of a logic analyzer. In addition, applications of a logic analyzer for troubleshooting microprocessor systems is also covered.
Prerequisites: Students should have taken the course on Principles of Microprocessor Systems, or have a good knowledge of microprocessors from other courses, or experience.
Who Should Attend: Engineers and technicians who are involved in any of the areas of design engineering, program development, or servicing of microprocessor systems. In general, those who see the need to use a logic analyzer, but require an understanding of the "mysteries" of such a powerful tool.
Course No. 1002TGF/4 $995

NEW Principles of Analog Oscilloscopes

General Technology

Course Objectives: This course is designed to provide the technician/engineer with an in-depth understanding of analog oscilloscope operation. An insight is provided to the inner workings of the vertical and horizontal deflection systems as a prelude to understanding applications. Other features such as the Triggering System and the Delayed Time Base System are covered via complete block diagrams so that their use can also be related to applications. One area of discussion involves the many measurement pitfalls which can be encountered, and how to avoid them. Interspersed with the lecture discussion are many hands-on exercises to ensure that the student fully understands the application involved.
Prerequisite: None.
Who Should Attend: Personnel who need familiarization with the more up-to-date oscilloscopes. Also, those who need a refresher course on scopes, and information on ways to better utilize an oscilloscope.
Course No. 1003TGF/2 Days $495

NEW Principles of Digital Oscilloscopes

General Technology

Course Objectives: Many functions of an oscilloscope are never used because the operator is either unaware, or unknowing with regard to their application. This course will bring all students up-to-date in the complete operation and applications of the digital oscilloscope. Technicians or Engineers who are new to the operation of Digital Oscilloscopes can benefit greatly from this course. In addition, those who need a refresher course on the many ways to use a digital scope can use this course as a means to get "up to speed" in a hurry.
Prerequisite: None.
Who Should Attend: Personnel who need familiarization with the more up-to-date oscilloscopes. Also, those who need a refresher course on scopes, and information on ways to better utilize an oscilloscope.
Course No. 1004 TGF/2 Days $495

Maintenance Training

(Unscheduled)

1722 Instrument Controller

Maintenance

Course Objectives: These two separate one-day courses will give you not only an extensive amount of hands-on operating time in which to gain experience and confidence on the use of the equipment, but you'll also troubleshoot the instrument to the module level. The use of built-in diagnostic capabilities will be covered in addition to the troubleshooting procedures.
Prerequisites: A formal education in digital and analog electronics theory. You should possess practical troubleshooting experience and a good working knowledge of basic test equipment used in measuring voltage, current, resistance, and waveforms.
Who Should Attend: Anyone who has a need to operate or repair their 1720 or 1722 Instrument Controller.
Course No. 1722-TMF/2 Days $495

2280 Data Logger

Maintenance

Course Objectives: This five-day maintenance training course will present to the student all the information needed to repair the unit to the module level. The practical aspects of maintenance and hands-on exercises are highly stressed. Given a defective 2280 Data Logger, a set of Manuals, tools and test equipment you will be able to repair the 2280 to the module level.
Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, current, resistance, andwaveforms in a troubleshooting atmosphere.
Who Should Attend: Technicians and supervisors who are required to maintain, calibrate, and repair their equipment.
Course No. 2280TMF/5 Days $1100

Customer Training

3040/3050 Board Tester
Maintenance

Course Objectives: Prepared with an understanding of the system layout, service manual organization, theory of operation, self test diagnostic operation, servicing techniques, adjustment procedures, and mechanical assemblies, it is the intention of this five day course that you be able to maintain and repair the 3050B to the major subassembly or board level.
Prerequisites: A formal education in electronics, including digital and analog theory. Practical hands-on experience troubleshooting complex systems. A working knowledge of basic test equipment used to measure voltage, current, resistance, and waveforms is a must. Additionally, a working knowledge of 3050 operation and programming is strongly suggested.
Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 3040/3050 Series equipment.
Course No. 3040TMF/5 Days $1100

3200 Board Tester
Maintenance

Course Objectives: Prepared with an understanding of the System Component locations, Theory of Operation, Special Diagnostic utility programs, Alignment checks and Troubleshooting Tests, it is the intention and objective of this five day course that you be able to maintain and repair the 3200B Manufacturing Defects Analyzer to the Subassembly, board, or module level.
Prerequisites: A formal education in electronics, including digital and analog theory. Practical hands-on experience troubleshooting complex systems. A working knowledge of basic test equipment used to measure voltage, current, resistance, and waveforms is a must. Additionally, a working knowledge of 3200 operation and programming is strongly suggested.
Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 3200B Series equipment.
Course No. 3200TMF/5 Days $1100

5100 Meter Calibrator
Maintenance

This five-day maintenance course is provided for those who wish to troubleshoot and repair their 5100 Series Meter Calibrator to the component level. The models covered in this course are the 5100B, 5101B, and 5102B.
Course Objectives: A thorough block diagram analysis, theory of operation, and troubleshooting discussion will provide the confidence needed to accomplish the troubleshooting and repairing of malfunctioning 5100 units. Intensive hands-on exercises will support the confidence level of each student.
Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, current, resistance, and waveforms in a troubleshooting atmosphere.
Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 5100 Series equipment.
Course No. 5100TMF/5 Days $1100

5200A Programmable AC Calibrator
Maintenance

This five-day maintenance course is provided for those who wish to troubleshoot and repair their 5200A AC Calibrator to the component level.
Course Objectives: A thorough block diagram analysis, theory of operation, and troubleshooting discussion will provide the confidence needed to accomplish the troubleshooting and repairing of malfunctioning 5200A units. Intensive hands-on exercises will support the confidence level of each student.
Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, current, resistance, and waveforms in a troubleshooting atmosphere.
Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 5200A equipment.
Course No. 5200TMF/5 Days $1100

8000 Series Digital Multimeter
Maintenance

Course Objectives: At this program, students will learn to

1) operate the 8000 Series Digital Multimeters to gain experience and confidence in their capabilities,
2) verify proper operation,
3) troubleshoot to the component or module level.

Prerequisites: Training in digital and analog electronics theory. Practical troubleshooting experience in complex systems and a working knowledge of basic voltage, current, resistance, and waveforms measurement equipment. A basic understanding of meter calibration sources or calibration laboratory experience is helpful but not required.
Who Should Attend: Technicians or supervisors who maintain the efficiency of the Fluke 8000A/8030A, 8010A/8012A, 8020A/8021B/8022A & B/8024A/8026A & B, 8040A/8050A, and 8060A/8062A Digital Multimeters.
Course No. 8000TMF/3 Days $700

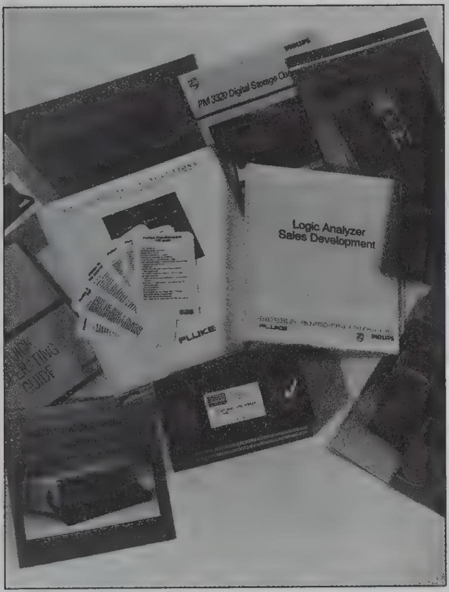
8500 Digital Multimeter
Maintenance

This training course will include maintenance on the 8500 Series DMMs. The models included in the course are the 8500A, 8502A, and 8506A.
Course Objectives: This five-day maintenance course is designed to give you the confidence to successfully troubleshoot the 8500 Series Digital Multimeters. Depending on your entry level, this troubleshooting will be accomplished to either the component or the module level.
Prerequisites: A formal education in digital and analog electronics theory. You should possess practical troubleshooting experience and a good working knowledge of basic test equipment.
Who Should Attend: Anyone desiring the information needed to repair their malfunctioning 8500 Series DMM.
Course No. 8500TMF/5 Days $1000

8840A Digital Multimeter
Maintenance

Course Objectives: In this four-day course you will learn to operate, calibrate, and maintain the 8840A. Additionally, you will learn to troubleshoot the unit to the component level.
Prerequisites: A formal education in digital and analog electronics theory. You should possess practical troubleshooting experience and a good working knowledge of basic test equipment used in measuring voltage, current, resistance, and waveforms.
Who Should Attend: Anyone who has a need to operate, calibrate, or repair their 8840 DMM.
Course No. 8840TMF/4 Days $920

Education Support Programs



Education Programs

Educational institutions face a tremendous challenge training tomorrow's electronic engineers and technicians. Continuous growth in technology along with perennial budgetary constraints make the educator's job of defining an electronic curriculm, choosing the right equipment and keeping that equipment in good working order a difficult task.

For many years Fluke and Philips have been working with many educators in facing this important obligation. Fluke's Educational Support Programs are centered around a broad array of rugged, high performance instruments, a worldwide network of service and support, a series of comprehensive training materials, all at competitive prices.

Product Reliability

Fluke and Philips are recognized in the electronics industry as premier suppliers of high performance industrial-grade test instrumentation, designed and built strong enough to take the toughest abuse. We recognize that a test instrument's application ranges from the laboratory to the production floor to remote field service sites and that users range from the highly skilled test engineer to the first-time technical trainee. Therefore, we design and build our instrumentation to be intuitively easy to use and to be able to withstand both physical and electrical mis-use. Most of our instruments meet or exceed the safety specifications outlined by UL, CSA and the European VDE. And our MTTF (Mean Time To Failure) specs attest to our rigorous design and Quality Control standards. In support of these claims for reliability, all of our instruments are backed by one-, two- or three year warranties.

Inherent quality and reliability pays big dividends in the classroom, where students subject equipment to heavy use, and sometimes, misuse. Where budgets for equipment maintenance, repair and calibration are limited, rugged, reliable instruments that keep on working can make a difference in today's full curriculums.

Product Breadth

Today's electronic education ranges from basic electrical theory to advanced electronics research. Fluke and Philips offer a broad array of instrumentation to meet these classroom and laboratory needs, all offering exceptional value.

Our products include real-time (analog) and storage oscilloscopes (analog and digital), handheld and bench digital multimeters, frequency counters and counter/timers, function generators, synthesized signal generators, digital testers, component testers (RCL Meters) and data acquisition equipment.

Of particular interest to those educators moving their students from the analog into the digital world are our oscilloscopes and DMMs that combine both analog and digital capability. Using both measurement modes, one gains a strong understanding for the vital aspects of the growing digital domain.

Today's electronic world increasingly requires that instruments and computers "talk" to each other via IEEE-488 or RS-232 links. The practical teaching of such concepts has been hampered until now by the complexity and high cost of such instruments and systems. Now, however, significant changes have made such teaching both more practical and affordable. Fluke/Philips offers the broadest array of low-cost building blocks for PC-based IEEE test systems available from any supplier in the world.

These building blocks include test instrumentation software (e.g., Test Team), IEEE-488 cards, modular interconnect switches (System 21), digital oscilloscopes, digital multimeters, counters, function generators, logic analyzers, microprocessor testers and more.

Whether your curriculum covers basic electronics or IEEE systems, your Fluke/Philips sales engineer can work with you, defining the equipment that best meets your needs.

Worldwide Support

When you choose a test equipment vendor, the product is just the first step. Fluke and Philips understand that selecting a vendor who backs that product with capable technical assistance and reliable, rapid and afforable service is a critical issue in your decision. Fluke and Philips rank "number 3" in sales of test instrumen- tation worldwide. That makes us large enough to have a network of service and support facilities to fully serve our cutomers yet small enough to give that "extra measure" of customer care long after the sale is concluded. For 40 years we have lived by the motto that we "... give the Customer a little bit more than he thought he paid for". Everyday, all of us at Fluke/Philips work hard to insure this motto gets translated into true customer satisfaction. (See previous Calibration & Repair Section for our array of flexible service agreements and plans.)

Training Tools

With the rapid changes in technology and electronics, schools are faced with a real dilemma in keeping their curriculum and the talents of their staff, up to date. Given today's increasingly powerful, complex instrumentation, this task becomes even more acute.

Fluke and Philips can help with an extensive array of training aids, including Basic Principles books, application notes, Quick Operating Guides, instruction manuals, service manuals and video tapes. In addition, a variety of product application courses, general technology workshops and maintenance training are also available.

One new course is specifically designed for instruments in educational institutions: 70 Series Solutions. The 70 Series has been Fluke's standard in digital multimeters, with industry using over a million units.

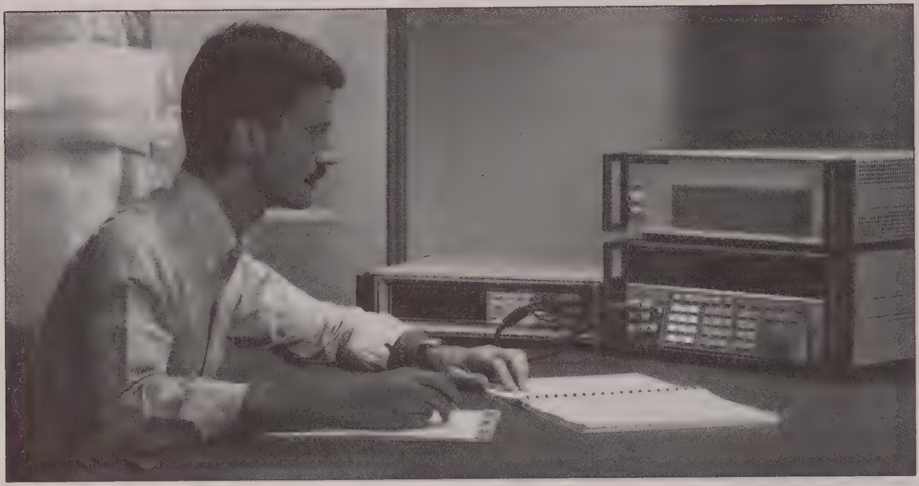
Fluke has created this instructor package, including instructor manual, training overheads, video tape and student workbooks. You can get started quickly in setting up this core, hands-on electronics lab, with an instrument that is widely used throughout the electronics test world.

Exceptional Value

The Fluke and Philips companies have built their reputation by serving customers with products of exceptional value — high performance, proven reliability and fair prices. Nowhere is this more important than in educational institutions. In addition to products of superior value, we also support the teaching community with a series of **EDUCATIONAL DISCOUNTS, GIFTING PROGRAMS, EXTENDED PRODUCT SUPPORT PLANS and TRAINING PACKAGES** designed specifically for education.

To see how we can effectively address YOUR teaching needs, contact your local Fluke sales office or call 1-800-443-5853, ext. 73.

Metrology Services



Metrology Services

- State-of-the-art, primary standards laboratory
- NIST (NBS) traceability
- Cost-effective convenience
- Two key customer-oriented programs
- Preparation for the "1990 Electrical Unit Change"

Fluke brings you the convenience of true service, with the highest accuracy standards. Our goal is to help you make your calibration lab the best it can be.

Our metrology services continue to expand to meet your needs.

Traceability Maintenance Programs

- DVMP
- 5700A Cal Package

These innovative, on-site calibration services are offered to Fluke customers as a convenient means for maintaining traceability for your most accurate electronic measuring equipment.

Direct Voltage Maintenance Program

The Direct Voltage Maintenance Program has been in operation since 1984. This popular on-site service provides you with near - NIST (NBS) accuracy for the 10 volt output of your DC reference standard without the inconveniences, cost and loss of use of sending your standard to NBS. For a complete description of this program, see page xxx.

Traceability Maintenance Programs for alternating voltage and for resistance are under development, and are expected to be available by mid 1989. For information on any of these programs, call (800) 443-5383, ext. 73.

5700A Artifact Calibration Package

Designed for the smaller facility which does not want the expense of owning and maintaining the 10 volt standard and resistors needed for periodic "Artifact Calibration" of the 5700A, this service will be available about March, 1989. We will send you a characterized 732A, 742A-A and 742A-10K plus the connecting cables and instructions you will need.

Standards Calibration Services

Send in your standards, we measure them and report their value. If it requires repair, arrangements are made with you to most effectively bring your standard back into specification. For more information on availability and price, phone (800) 443-5853, ext. 73.

The Changing Volt

What's Happening

On January 1, 1990, the world will adopt a new worldwide standard of voltage. The change from the old standards is being made so everyone will have the same volt and instruments calibrated in one country will measure accurately in another.

At present, there are several "volts", each slightly different from the U.S. volt, and nearly 8 ppm different from the SI volt, which is the "real volt". In January 1990, each country will adjust its volt by the amount needed to make it correspond to the SI volt. In Canada and Europe, the change will be about 8 ppm, in the U.S., about 9 ppm.

Small changes will be made in the values of the ohm, kilogram and the temperature scale at the same time. The amount and direction of all these changes will be decided in late 1988 or early 1989.

How Will It Affect You?

Many calibrators and meters have enough accuracy that a change of 8 or 9 ppm in their calibration will be enough to seriously affect their ability to perform to specifications. These instruments must be identified and steps taken to prevent erroneous measurements. Other quantities will also change because of the change in the volt. These include the ampere and the watt.

As a rule, any instrument having specified uncertainty of +/- 50 ppm or less for direct voltage, alternating voltage, AC or DC current or power will require action to prevent errors. Some instruments having uncertainties between 50 ppm and 100 ppm MAY be affected. These instruments should be identified and looked at on an individual basis.

It will be impossible to recalibrate all the affected instruments at once, so there will be a transition period in which both volts exist in the same facility. To avoid mistakes, instruments must be clearly marked to show which volt is being used. Standard stickers will be made available for marking instruments calibrated to the old volt and to the new volt.

Changes in the ohm, the kilogram, and the temperature scale will be too small to impact large numbers of instruments. The effect of these changes will hardly be felt outside the standards laboratory, and there they will most likely be handled by means of paperwork changes to the values assigned to standards which maintain those quantities.

How Will Fluke Help?

Fluke engineers and metrologists participate on the committee NIST (NBS) set up to ease the transition to the new units, and is in close contact with what is happening. Fluke will offer several programs to assist you in making the change easily and economically:

- Fluke customers will be sent the necessary information and instructions as they become available.
- Fluke will make available the "new volt" and the "old volt" stickers.
- After mid-1989, Fluke instruments will be shipped with the "old volt" stickers. When the change is made at Fluke, instruments will be shipped with the "new volt" sticker.
- The Fluke Direct Voltage Maintenance Program is prepared to assist you in adjusting your most accurate voltage standards.
- The Fluke Technical Centers are ready to help you recalibrate your workload of meters and calibrators.

Service Information

Ask your local Technical Center for a copy of any literature you may need. Or use a reply card, if you prefer. Please use both title and number.

Digital Multimeters and Voltmeters

Auto-Zero Circuit 8300A, Inverting Amplifier	C0045
Digital Voltmeter Guard Terminal Connection	C0048
Installation of Fuse Holder in the 8300A MV/Ohm	C0055
Troubleshooting the 8500A Utilizing Its Modular Structure	TB-10
Use of Millivolt/Ohm Option for 8300A DVM on 50 Hertz	C0047
1910/11A Counter Series	SB-75
80F-5/15 Improved Shock Protection	C0066
8000A Troubleshooting	TB-12
8000A Digital IC Replacement	C0062
8000A/mAS High Voltage Protection	C0065
802XB AC Reading During Overloads	C0092
8100A Battery Pack Recharge Cycles	C0053
8100A Battery Pack Repair and Replacement	C0049
8100A In-Circuit FET Leakage Tests	C0044
8100A, 8110A, 8120A, 8125A AC Linearity Tests	C0050
8100A, 8110A & 8120A 1000 Range Hi-Pot Failure	C0054
8030/8040 Battery Fuse Protection	C0069
8500A Calibration Memory Battery Replacement	C0070
8800A Ohms Converter Replacement	C0068
931A Digit Switch Installation Instructions	C0042

Calibration

Improving Reliability in Systems Use of 3330B	C0082
332B/D; 335A/D Calibration Access Warning Decal	C0072
332D & 335A Replacement of Lamps w/LEDs	C0063
330B Power Line Wiring Modification	C0060
3330B Reliability Improvements	C0088
341A/343A LED Replacement	C0084
5100 Series Plug-In Relay Replacement	C0073
5100 Troubleshooting Information	B0086
5100/5101 Power Supply Fuse Installation	C0087
515A Battery Pack Mounting	C0086
5200A Oscillator Assembly Component Selection	C0085
5205 Troubleshooting Notes & Procedures	C0083
5205A/5215A LED Loop Bandwidth Calibration	C0067
5205A/5215A Operating, Cleaning & Servicing Notes	C0080
5205A/5215A Reliability Enhancement	C0097
New Design Developments Simplify Calibrator Support	F0106
720A Linearity Drift with Time	C0058
760A Switch Maintenance and Replacement	C0043
7405A Automated Calibration System Preparation	C0094
7410A Automated Calibration System Preparation	C0089
The Life-Cycle Costing Approach to Instrument Selection	F0109

Data Loggers

2200B & 2240B Data Logger Memory Loss	C0076

High Voltage Power Supplies

Safety Check of Line Fuseholder Wiring (410B)	C0079
415B Over Current Modification	C0052

General

Component Replacement Techniques	C0071
Fluke Instrument Switches	C0064
Preventing Electrostatic Damage During Service	C0081
Troubleshooting Into IEEE-488	C0076
Troubleshooting AC Converters	C0090
Preventive Maintenance for Internal Ni-Cad Batteries	C0093

Customer Support Services Data Sheets

Digital Multimeter Repair and Calibration	E0221
Fluke Module Exchange Program	E0031
Repair and Calibration Services	E0225
FCS – A Commitment to Systems Solutions	G0137
1722A Product Update	M0007
1722A to 1752A Product Update	M0009
2280A to 2280B Product Update	M0006
2400A to 2400B Product Update	M0008
5440A to 5440B Product Update	M0005

Applications Training Data Sheets

1722/1752 Instrument Controller Software & Applications Training	E0238
2452 Measurement Control System Software & Applications Training	E0241
7400 Series Calibration Systems Procedure Writing	E0229
2280A/B Data Logger Product Introduction	E0228
9010 Board Tester Troubleshooting Training	E0242
9010 Board Tester Programming Training	E0243
FlexSys Software Training	E0239
Metrology for Technicians	A0260

Maintenance Training Data Sheets

1722A Instrument Controller Maintenance	E0234
2280A/B Data Logger Maintenance	E0235
2452 Measurement Control System Maintenance	E0240
3040A/3050B Board Tester Maintenance	E0236
3200B Board Tester Maintenance	E0230
5100 Series Meter Calibrator Maintenance	E0231
5200 Programmable AC Calibrator Maintenance	E0227
8500 Series Digital Multimeter Maintenance	E0232
8840 Digital Multimeter Maintenance	E0233
8000 Series DMM Maintenance	E0237

Specials

Fluke Customer Training Brochure (multi-page)	E0224
Fluke 1988 Course Planner (poster)	O0016

Application Information

Ask your Sales Office or Representative for a copy of any literature you may need. Or use a reply card, if you prefer. Please use both title and number.

Microprocessor Board Testers: 90 Series

Emulation Testing of Microprocessor Based Equipment (EE 6/88)	F0110
Field Testing Before the Sale	F0111
Equipment Reports	F0112
Repairing Microprocessor-Based Equipment	F0113

Micro-System Troubleshooters: 9100/9000 Series

Remote Operation	B0147
9000/9100 Series User Designed Interface Pod Adapters	B0156
The Probe and the Program	B0163
Using the Fluke 9000 Series Micro-System Troubleshooter to Test and Troubleshoot Video Controllers	B0168
Portable Tester Learn Boards to Simplify Service (Electronics, 6/81)	F0016
KCST-TV 9010A Field Report (Broadcast Engineering, 10/85)	F0055
Taming SMD-Based Boards with Design for Test and Test Automation (Electronic Test 5/87)	F0072
Introductory Training Manual Micro-System Troubleshooters (9000A Series)	J0178
9100A Production Testing	L0030
Fluke Troubleshooter – A Collection of Articles for Micro-System Troubleshooter Users (Replaces all earlier newsletters):	
For all of 1983 issues	P0003
For all of 1984 issues	P0009
For all of 1985 issues	P0014

PC Board Testers: 3000 Series/3200 Series

Unconnected Output Errors	L0006
Counter Initialization Functional Testing (3000 Series)	L0010
Testing Static Memories (3000 Series)	L0014
Pin Electronics for the 3050A	L0016
Expanding Models 3040A/3050A to Test PCBs With More Than 240 Pins	L0018

Digital Multimeters and Voltmeters

Using the 8520A DMM's Math Programs	B0075
8520A Burst Measurements	B0107
Analog Bar Graph Applications Using Fluke 70 Series Multimeter	B0158
Automotive Applications for Fluke Multimeters	B0164
Electrical Troubleshooting With Fluke Multimeters	B0171
A Test Lab in Your Toolbox. The Fluke 8060A	B0172
The On-Site Fluke Story (Model 77) (Vector, May 1984)	F0036
Digital Multimeter Packaging Tackles Harsh Environments (Electronic Packaging & Production, 10/84)	F0045
Fault Protection for Digital Multimeters (Electrical Construction & Maintenance magazine, 2/87)	F0066
Reliability of Handheld DMMs (Quality magazine, 12/86)	F0067
How to Select a Multimeter	F0102
Selecting True RMS & Averaging DMMs	G0098
Multimeter Safety	G0101
The ABCs of DMMs	G0102

Calibration

Cost Optimized Calibration 5100B Series	B0055
Additional 7105A Calibration Techniques	B0141
Questions & Answers on the 5440A Direct Voltage Calibrator	B0152
Understanding the 5440 Series	B0170
Interpreting Specifications of Calibration Instruments	B0174
Calibration – Philosophy in Practice	E0010
International Standards - It is a Small World After All (Quality magazine, 8/86)	F0061
Is There a Need for a Calibration Lab? (Quality magazine, 10/86)	F0062
The Changing of the Guard: Buying the Right Calibration Instrument (Electronic Test, 12/86)	F0068
Calibrators/Calibration Standards. Are You Confusing the Calibrator With Calibration (EE 4/87)	F0069

Calibration Moves Out of the Laboratory (Test & Measurement World 5/87)	F0071
New Design Developments Simplify Calibrator Support	F0106
The Life-Cycle Costing Approach to Instrument Selection	F0078
Precision Direct Voltage and Ratio Calibration System with Standards Room Accuracy	L0020

Computer-Aided Calibration: 7400 Series/A123 Series

Automated Calibration System	L0021
Mobile Automated Calibration System	L0022

Instrument/System Controllers: 1720A/1722A/1752A

An Introduction to Virtual Arrays	B0143
Programming with Virtual Arrays	B0144
Plotter Routine Library	B0162
Interfacing with an Epson FX-Series Printer	B0166
ATLAS: Programming for ATE (Avionics Magazine, 1986)	F0060

Data Acquisition Data Loggers: 2280 SERIES/2200B/2240C

Road Testing With a Battery Powered 2280A Data Logger	AL-1041/D0027
Using the 2280A to Test a Fluidized Coal Pilot Plant	AL-1044/D0030
Using the 2280A to Test Digital Audio Disks	AL-1045/D0031
Using the 2280A Data Logger to Test Power Supplies	AL-1046/D0032
Using the 2280A Data Logger to Test Helicopter Air Speed Sensors	AL-1047/D0033
Data Logger Expands to 1500 Point/Data Acquisition and Control System (Control Engineering 9/82)	F0025
Data Loggers in Test Measurement (Test & Measurement World 9/83)	F0033
Trunk-Mounted Data Logger Road Tests Chrysler Cars (Industrial and Process Control magazine, 7/84)	F0043
Data Logger Helps Reduce Cost in Brewery (Industrial and Process Control magazine, 6/85)	F0052
2280A Data Logger Operator's Notebook	J0222

Data Acquisition/Computer Front Ends/ Process Control: 2400B/2452MCS

Intelligent Computer Front End – Software Dialog	A0202
For Fire Testing	AL-1032/D0018
To Monitor Remote TV Transmitting Stations	AL-1033/D0020
To Test Steam Turbines	AL-1034/D0019
To Control Hot Runner Temperatures in a Plastic Injection Molding Process	AL-1035/D0021
For Wire Harness Testing	AL-1036/D0022
To Monitor a Gas Pipeline Main Compressor Station	AL-1037/D0023
To Monitor a Steel Mill's Basic Oxygen Furnaces	AL-1038/D0024
To Control Stress and Rupture Testing Furnaces	AL-1039/D0025
Using the 2400A for Environmental Testing of Electronic Components	AL-1040/D0026
Using the 2400A to Monitor and Control Petrochemical Pilot Plants	AL-1042/D0028
Using the 2452MCS with Stepper Motor Controller Option to Run a Factory Pick-and-Place Machine	AL-1043/D0029
Using the 2400A Series for Gas Flow Metering & Control	AL-1049/D0035
Furnace Control and Monitoring	AL-1050/D0036
2400B-001 Serial Interface	B0159
Runnerless Tooling: A Fast and Reliable Way to Mold Any Material (Modern Plastics 10/83)	F0030
Flexible Test Systems Cut Costs and Hike Production-Line Turnarounds (Electronics 5/84)	F0037
Efficiency of Chemical Process Development Increased by Computerized Control System (Chemical Processing 10/84)	F0047
Programming Control Algorithms (Chemical Engineering magazine, 3/18/85) (incorrectly labeled as F005)	F0050

Touch-Control Equipment: 1020/1030 Series/1780A

Interfacing 1020 Series Touch Control Screens to Programmable Logic Controllers	L0023
Adding Touch Control Screens to Allen-Bradley Programmable Logic Control Systems	L0024
Fluke Touch Control Screens Provide Versatile New Operator Controls for Stamping Presses	L0025
Adding Touch Control to Texas Instruments Series 500 Controllers	L0026
Adding Touch Control Screens to Square D Programmable Controllers	L0027
Linking Data Collection Devices to the Fluke Touch Control Screens	L0031

Digital Thermometers

Total Instrument Accuracy for Digital Thermometers (Was AB-29)	B0005
Test or Calibrate Thermocouple or Millivolt Indicators (2190 + Y2003) (Was AB-47)	B0059
2300A Temperature Scanner: Typical PTI Applications (Was AB-51)	B0074
Case Studies in Temperature Measurement	AL-1048/D0034
Thermocouples, RTDs Can Boost Temperature Measurement Accuracy (Industrial Research & Development 11/83)	F0031
Fluke 52K/J Thermometer (Hands on Electronics 5/87)	F0070
The ABCs of Thermometers	G0145

Printers

"Computing" Printer Solution – Some Typical Instrumentation Applications (2030A) (Was AB-50)	B0068

Signal Sources

Systems Use of the 6011A Synthesized Signal Generator	AB-22/B0048
Signal Generator Primer	B0121
Filter Testing Using the 6070A and 6071A Synthesized Signal Generators	B0124
Delay Lines Give RF Generator Spectral Purity, Programmability (Electronics 8/80)	F0013
Low Cost Signal Generator Features 2.1 GHz Range and Pulse Modulation (rf design 4/87)	F0073

General

IEEE Standard 488-197 Digital Interface for Programmable Instrumentation	AB-36/B0053

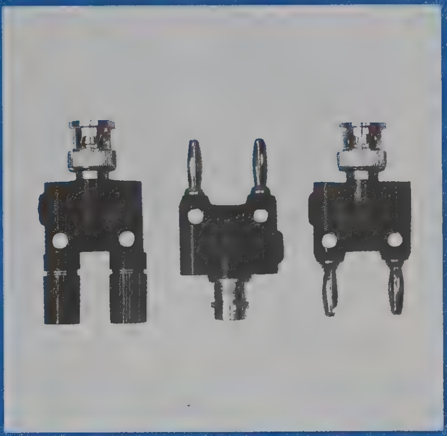
GPIB System 21

GPIB System Increases High Tech Production Test Flexibility	9498 728 00813
GPIB System Improves Metal Resistor Production Technique	9498 728 00913
GPIB System Speeds Bus Command Response Time Checking	9498 728 01013
GPIB Ensures Correct Connections in Semi-Automatic Testing	9498 728 01113
GPIB Simplifies Burn-In Testing for Multimeters	9498 728 01213
GPIB System Guarantees Long-Term Diode Performance	9498 728 01313
GPIB System Speeds Up Heat Meter Calibration	9498 728 01413
GPIB System Speeds Oscilloscope Calibration	9498 728 01513
GPIB System Speeds Calibration of Crystal Oscillators	9498 728 01613

Various

Basic Principles and Measuring Techniques of the Philips VHF Oscilloscopes	9498 720 01214
PM 8271/72 Quick Operating Card	9498 727 00519
PM 3570 Quick Operating Guide	9498 505 01511
PM 3320 Quick Operating Guide	9498 449 05911
PM 3285A/95A Quick Operating Guide	9498 720 01319
PM 3050/55 Quick Operating Card	9498 720 00819
PM 3632 Short Operating Guidd	9498 505 01311
PM 3360 in Materials Testing	9498 443 04811
PM 3360 Advanced Measurement Solutions	9498 443 05011
PM 3305 Quick Operating Guide	9498 445 04611
PM 3360 Qick Operating Guide	9498 445 04811
PM 3305 Automotive Industry	9498 445 05611
PM 3360 Quality Control in TV and Video	9498 445 05511
PM 3360 Quality Control in Electrical Engineering	9498 720 00614
PM 3360 Quality Control in Mechanical Engineering	9498 720 00714
PM 3360 in the Automotive Industry	9498 720 01414
PM 3360 for Mains Analysis	9498 720 01516
PM 2618 MAS Multimeter for Medical Applications	9498 477 01511

General Accessories



BNC-Banana Adapters

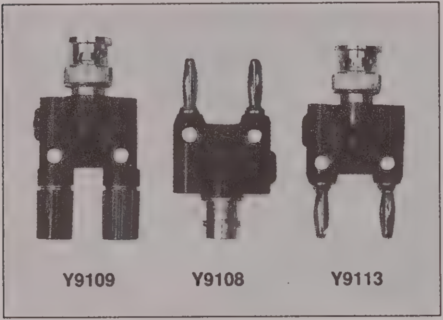
This section includes an assortment of general instrument accessories that are compatible with a wide variety of Fluke and Philips instruments and products. Please also refer to the individual product sections in this catalog, as well as the alphabetical index, for specifications and ordering information on other accessories designed specifically for use with particular products.

Cables

Rack Adapters

Adapters 486
Connectors 486
Cables 487
Rack Adapters 488

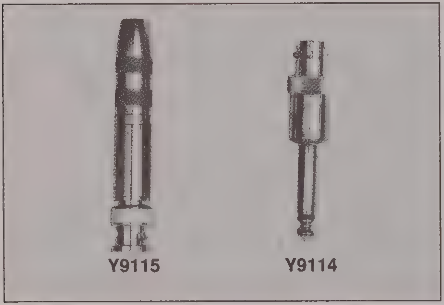
Also see page 127 for other accessories.



BNC-Banana Adapters*

BNC-to-banana adapters permit interconnection between equipment having BNC plugs or jacks and equipment with double banana plugs or jacks.

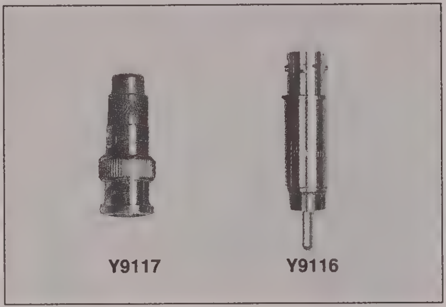
Y9108** BNC Jack to Double Banana Plugs	$15
Y9109** Binding Posts to BNC Plug	20
Y9113** BNC Plug to Double Banana Plugs	20



Phone Adapters*

Adapters permit interconnection between equipment with phone plugs and equipment with BNC our double banana plug connectors.

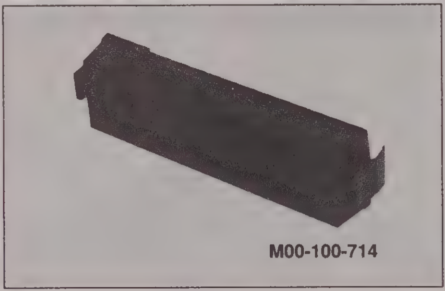
Y9114** BNC Jack to Phone Plug	$20
Y9115** Phone Jack to BNC Plug	20



Phono Adapters*

Adapters allow interconnection between equipment having phono connectors and BNC connectors.

Y9116** BNC Jack to Phono Plug	$20
Y9117** Phono Jack to BNC Plug	20

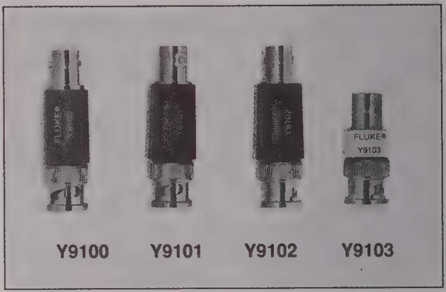


M00-100-714 Panel Protectors

A front panel protector is a molded plastic, snap-on accessory which fits over the front panel of a DMM, counter, etc. The cover provides protection for the front panel controls, and is useful for storing or transporting the instrument.

M00-100-714 is designed to fit the 8000A and 8600A DMM, and the 1900A, 1910A, 1911A, 1912A Counters. M03-203-700 is designed to fit the 515A Calibrator and the discontinued 8200A DMM.

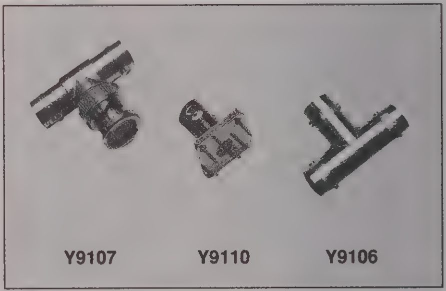
M00-100-714** Dust Cover	$10
M03-203-700* Dust Cover	25



BNC 50-Ohm Attenuators, etc.

BNC 50-ohm, 2-watt attenuators for use with VHF and UHF instruments:

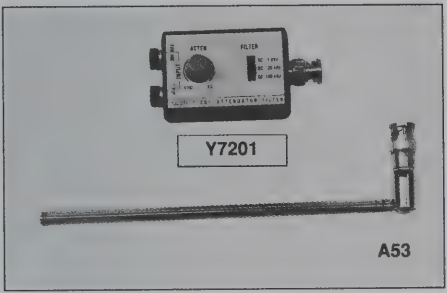
Y9100** 6 dB Attenuator	$55
Y9101** 14 dB Attenuator	55
Y9102** 20 dB Attenuator	55
Y9103** BNC 508 feedthru terminator	35
Y9301 Min-Loss Pad, 50Ω to 75Ω, Type N	260
Y9317 50Ω Termination, Shielded, Type N	95



BNC Connectors

Y9107** BNC "T" Jack, Plug, Jack	$15
Y9110** BNC Jack to PC Pins	20
Y9106** BNC "T" 3 Jacks	20
Y9307 Adapter, N to BNC, 75Ω	20
Y9308 Adapter, N to BNC, 50Ω	20
Y9316 Cap, Non-Shorting, BNC	10

** These adapters and exposed metal connectors should not be used for floating measurements that are greater than 30V ac, 42V peak or 60V dc above earth ground.*
***Available through Distributors*



Y7201 Attenuator/Filter

The Y7201 is a combination variable attenuator and selectable low pass filter which can be used for input signal conditioning on all Fluke counters.

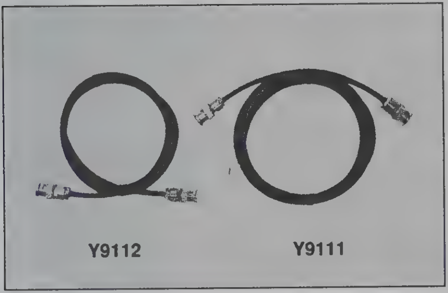
Input Impedance: 47 kΩ
Attenuation Range: ÷5 to ÷100, continuously adjustable
Low Pass Filter: 1 kHz, 20 kHz, or 100 kHz switch-selectable
Maximum Input: 30V

Y7201** Attenuator/Filter (Counters)	$65

A53 Telescopic Whip Antenna

Telescopic Whip Antenna connects to input of all counters. Uses swivel BNC connector. Permits measurements without direct cable connections whenever input signal strength is sufficient.

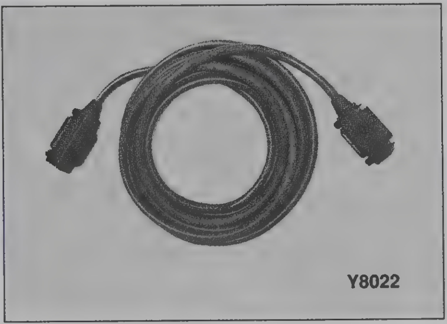
A53** Telescopic Whip Antenna	$30



50Ω BNC Coaxial Cables*

RG-58 C/U coaxial cables with BNC connectors (plugs) on each end are available in two lengths:

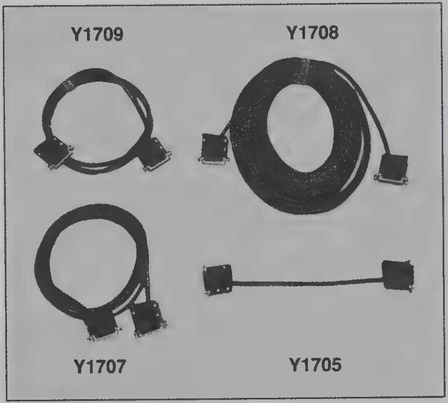
Y9111** BNC Cable 0.93m (3 ft) 50Ω	$20
Y9112** BNC Cable 1.85m (6 ft) 50Ω	20
Y9315 Coaxial Cable, N Mate	65



IEEE-488-Compatible Cables

A series of cables in three lengths are used to connect instruments to each other and to the IEEE-488 Bus. Each cable end has both a plug and a jack and are shielded.

Y8021 Shielded IEEE-488 Cable 1m (39.4")	$125
Y8022 Shielded IEEE-488 Cable 2m (78.8")	135
Y8023 Shielded IEEE-488 Cable 4m (13')	145

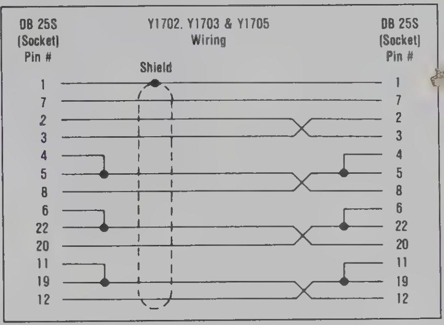


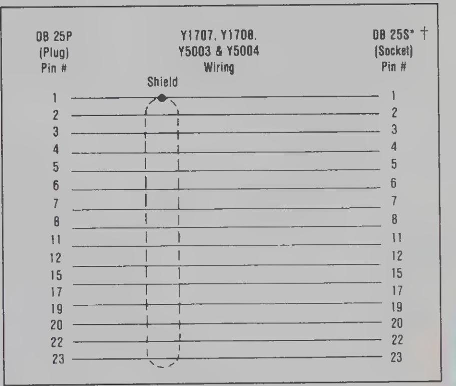
RS-232 Cables

These cables are to connect instrument controllers, terminals, modems, printers, etc. to other similar equipment compatible with EIA Standard RS-232-C.

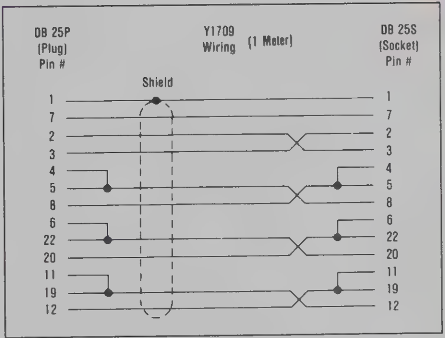
Y1702 Null Modem Cable 2m (6.56 ft)	$125
Y1703 Null Modem Cable 4m (13 ft)	150
Y1705 Null Modem Cable 30m (1 ft)	75
Y1707 Interface Cable 2m (6.56 ft)	125
Y1708 Interface Cable 10m (32.8 ft)	150
Y1709 Printer Cable 1m (3.28 ft)	125
Y5003 Interface Cable 1.52m (5 ft)	130
Y5004 Interface Cable 3.05m (10 ft)	140

RS-232 Cable Wiring





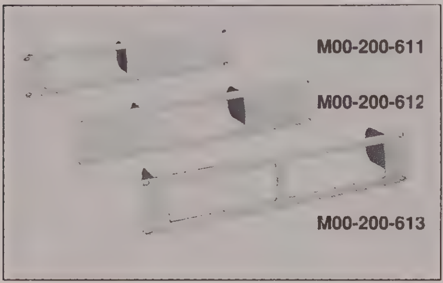
† DB 25P for Y5003 and Y5004



Rack-Width Rack Adapters

Fluke bench/systems instruments are designed to be easily mounted in a standard 19-inch rack cabinet. Some have rack-mount panels and some need rack adapters. When adapters are required they are listed with the instrument – among its recommended accessories.

Portable Instrument Rack Adapters



Multimeter Rack Adapters 3-1/2" High

8000A, 8010A, 8012A, 8050A, 8600A: M00-200-611, M00-200-612 & M00-200-613
8840A, 8842A, 8840A/AF: Y8834 and Y8835

Y8834 Single Rack Mount Kit, 8840A, 8842A	$45
Y8835 Dual Rack Mount Kit, 8840A, 8842A	100

Counter Rack Adapters 3-1/2" High

1900A, 1910A, 1911A, 1912A: M00-200-611, M00-200-612 & M00-200-613

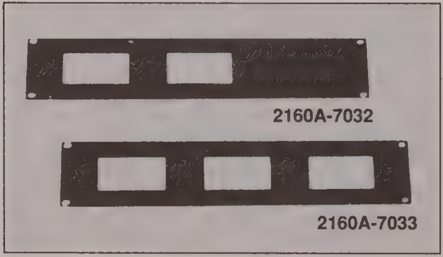
Thermometer Rack Adapters
3-1/2" High

2165A, 2166A, 2168A, 2175A, 2176A: M00-200-611, M00-200-612 & M00-200-613

M00-200-611** 3-1/2" Rack Mount Kit, Offset	$50
M00-200-612** 3-1/2" Rack Mount Kit, Center	50
M00-200-613** 3-1/2" Rack Mount Kit, Dual	60

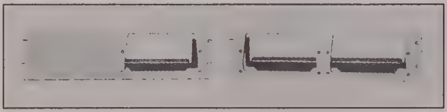
* *These adapters and exposed metal connectors should not be used for floating measurements that are greater than 30V ac, 42V peak or 60V dc above earth ground.*
** *Available through Distributors*

Panel-Mount Thermometer Adapters



Either the 2160A or the 2170A Thermometer may be mounted in these rack-width panels that are 3-1/2 inches high. Also, the 2161A Multipoint Selector and 2162A Digital Comparator will fit the panel openings.

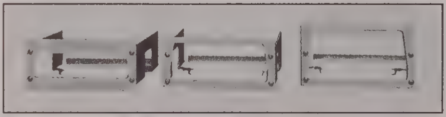
2160A-7032** 3-1/2" Rack Mount Panel Kit, Double	$90
2160A-7033** 3-1/2" Rack Mount Panel Kit, Triple	90



PTI-Style Instrument Adapters

Rack adapters for the 2180- and 2190-Series Thermometers, 7200 Series Counters, 8920 Series DVMs, and other Fluke products in PTI cases look like those shown in the picture except for the size of the opening or height of the panel.

PTI Case Style	Panel Opening		Rack Panel Size	
	Single	Double	Height	Width
A	Y2010	Y2011	3-1/2 in (89 mm)	19 in (483 mm)
B C	Y2012 Y2014	Y2013 Y2015	5-1/4 in (133 mm)	
D	Y2016	Y2017	7 in (177.8 mm)	
A+C	–	Y2027	5-1/4 in (133 mm)	



PTI-Style Instrument Panel Adapters

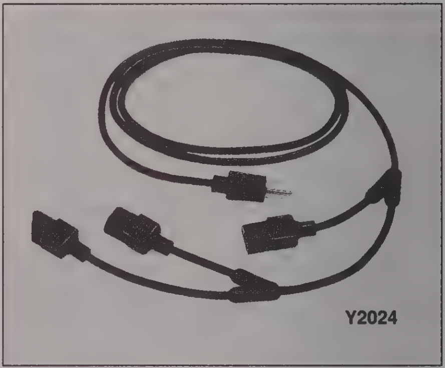
Fluke instruments in PTI-style cases may be mounted behind your own panel through a standard size panel opening by using one of the adapters identified below.

PTI Case Style	Adapt. No.	Panel-Mount Adapters			
		Panel Cutout		Bezel Size	
		Height	Width	Height	Width
A	Y2018	92 mm (3.62 in)	186 mm (7.32 in)	97 mm (3.82 in)	214 mm (8.43 in)
B	Y2019	92 mm (3.62 in)		97 mm (3.82 in)	
C	Y2020	†		122mm (4.80 in)	
D	Y2021	138 mm (5.43 in)		145 mm (5.70 in)	

† *Any dimension from 96 mm to 116 mm. Not Standard. Each kit fastens to a panel with four machine screws. The bezel fits over the front of the panel cutout and the screws hold the bezel and rear (instrument) support bracket to the panel.*

PTI-Style Instruments

PTI Instruments & Accessories	PTI Case Style A	B	C	D
1120A			•	
2020A, 2030A, 2300A				•
2180A, 2189A, 2190			•	
Y2000, Y2001	•			
Y2002			•	
Y2003, Y2009		•		
7220A, 7250A, 7260A, 7261A			•	
8860A				•
8920A, 8921A, 8922A			•	
Y5020				•
Y2023			•	



Y2024 3-Module Power Cord

Three 3-wire receptacles for powering two or three PTI-style instruments from one power outlet.

PTI Case Dimensions

Style	Height	Width	Depth
A	57 mm (2.25 in)	205 mm (8.05 in)	326 mm (12.85 in)
B	82 mm (3.23 in)		
C	105 mm (4.13 in)		
D	128 mm (5.03 in)		

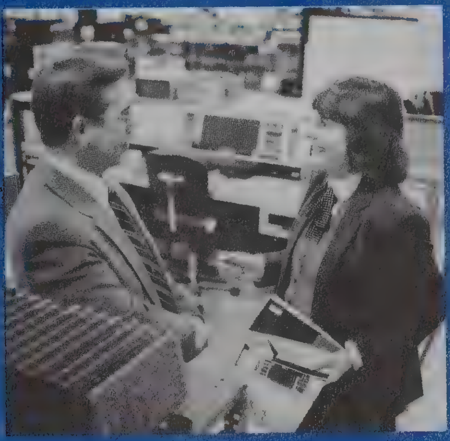
Ordering Information

Models

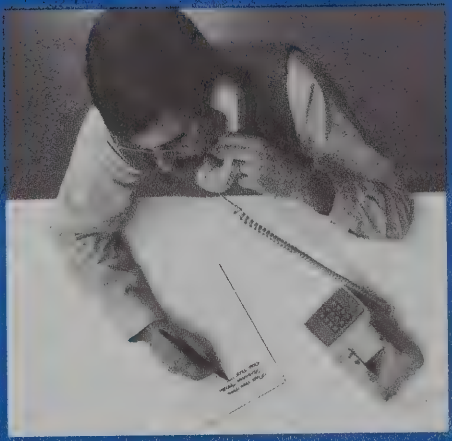
January 1989 prices

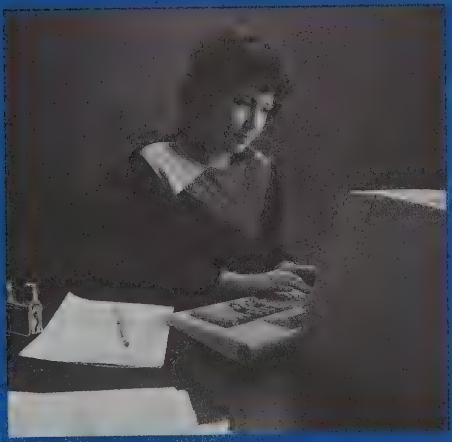
Y2010 3-1/2" Rack Mount Kit PTI, Single	$95
Y2014 5-1/4" Rack Mount Kit PTI, Single	95
Y2015 5-1/4" Rack Mount Kit PTI, Double	95
Y2016 17" Rack Mount Kit PTI, Single	95
Y2017 17" Rack Mount Kit PTI, Double	95
Y2020 4.80" DIN Panel Mount Kit PTI	95
Y2021 5.70" DIN Panel Mount Kit PTI	95
Y2024 3-Module Power Cord	21

Ordering Information



Ordering Fluke and Philips products is as easy and convenient as picking up the phone. Fluke and Philips Sales Offices, Representatives and Authorized Industrial Distributors are located worldwide to provide you with immediate sales assistance, on your local level. For U.S. Government purchases, we also have strategically located sales specialists ready to assist your needs. For details on pricing, delivery and terms, to technical information regarding the suitability of a particular product for a specific application, Fluke and Philips can help. Give us a call.





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Call Guide .... Inside Back Cover

Ordering Information

Working With Fluke

Fluke's sales and service organization is built around one single premise: To give you, our customer, an extra measure of value in everything we do for you. The large number of convenient local Fluke sales offices, technical service centers, distributors and representatives around the world is a reflection of that commitment.

Your Local Fluke Sales Office

Your introduction to Fluke and Philips products and services is your local Fluke sales office. The majority of these offices are linked to the Fluke factory, which means you can get information you need on our products and services, fast and accurately. A complete listing of sales offices begins on page 504.

Call Your Local Fluke Sales Office for:

• Application Assistance

A Fluke sales engineer can answer your questions and help you identify the Fluke and Philips equipment that meets your application. The sales engineer is backed by application engineers and factory specialists who can help create solutions for your test, measurement and control problems.

• Product Demonstrations

Demonstrations of a particular Fluke or Philips instrument may be arranged through your local Fluke sales office. A large inventory is maintained of many Fluke and Philips instruments for demonstration purposes, and we will make every effort to accomodate your needs. Fluke and Philips products are also displayed at many trade shows throughout the year. And also look for the Fluke and Philips unique mobile electronics exhibit vans. They regularly travel throughout the U.S., visiting key customer sites. We also welcome you at the Fluke factory in Everett, Washington. Your local Fluke sales office can help arrange a factory visit, and tell you more about our trade show and van schedule.

• Custom Instruments and Systems

Many Fluke and Philips instruments can be supplied in different colors, with altered specification ranges, special connectors, or other special features. Some systems may also be assembled and customized to your requirements. Fluke also gives you access to FCS — Fluke Cooperative Services. FCS is a network of independent specialists who know hardware, software, and your industry. FCS is for project managers, production managers, systems engineers — anyone who needs total test, measurement, and control systems solutions. Call your local Fluke sales office for more information.

• Quotations

Often times it is difficult to know exactly what is needed in regards to options, accessories, and service packages for the instrumentation you need us to quote. Your local Fluke sales office can help. Each is staffed by professional sales engineers who are ready to assist you in preparing quotes on any of the products found in this catalog. Simply call or write your local Fluke sales offices for immediate quotation service. If you have any special requirements unique to your request, please be as specific as possible, so that we may be able to provide you with a quote that reflects exactly what you need.

• Placing Your Order

In many instances, the information contained within this catalog will be sufficient for you to decide on which product or service you wish to purchase. In these events, a phone call to your local Fluke Sales Office can provide you with product availability and pricing. When placing your order, please be sure to specify the product's order number (model, accessory, or part) as well as the product name. It's best to be as complete as possible. Once the order is placed, you will receive confirmation of your order, along with a scheduled ship date.

Fluke Technical Service Centers

Strategically located in major markets throughout the world, our technical service centers are equipped with the necessary instruments, standards, procedures and personnel to help you maintain Fluke and Philips products to peak performance. To order repairs, calibration services, service agreements, call the Technical Service Center nearest you. A complete listing is shown on page 497.

U.S. Government Sales & Support

Fluke's Government Operations Group can provide you with the latest information on provisioning, nomenclature, and National Stock Numbers. They can also provide ordering assistance and guidance for the many special Fluke and Philips products, systems, and services that specifically support Government applications. Most of the instruments in this catalog are available on General Service Administration Contracts. A complete listing of U.S. Government Sales and Support offices are on page 492.

The Fluke Factory

Call the Fluke Factory for:

• Replacement Parts Orders and Module Exchange

All orders for replacement parts and module exchanges can be placed by calling 1-800-526-4731, in Alaska, Hawaii and Washington call (206) 356-5774. A trained specialist for both Fluke and Philips product lines will assist you in answering price and delivery questions and will take your order.

• Export Shipments

Questions on licensing issues, shipping costs, proforma invoices, power cords, etc. can be answered by calling Fluke's export sales office at (206) 356-5112.

•Training

Any training questions at all can be answered by calling 1-800-44-FLUKE, ext 73.

• Before and After Sales Application Assistance

If your local sales engineer isn't readily available, Fluke offers a toll-free telephone service to provide immediate answers to questions you may have regarding the suitability of a product for a particular application, or operational assistance regarding the product itself. You may also call this number to find the location of your nearest Fluke Sales Office or authorized distributor. Call 1-800-44-FLUKE.

Fluke Distributors

Distributors in over 500 U.S. locations stock many Fluke products for immediate delivery. Products include such instruments as handheld/benchtop digital multimeters, thermometers, and accessories. Fluke products carried at distributor locations are footnoted in the product index pages at the beginning of this catalog. Also, there is a phrase stating "Available through Fluke Distributors" in the ordering information block for each specific product described throughout the catalog. (To purchase distributor-sold products in quantities more than 50, contact your Fluke Sales Office.)

For the Fluke Distributor located closest to you, see pages 500, 501 and page 502. Or call 1-800-44-FLUKE.

The Fluke Warranty

Fluke warrants each product it sells to be free from defects in material and workmanship under normal use and service. Software is warranted to operate in accordance with its programmed instructions on appropriate Fluke or Philips products; it is not warranted to be error free. This warranty extends only to the original purchaser and does not apply to fuses, computer media, batteries or any product which, in Fluke's sole opinion, has been subject to misuse, alteration or abnormal conditions of operation or handling. The warranty period is controlled by the warranty document furnished with each product and begins on the date of shipment. For specific warranty periods, refer to the appropriate product page in this catalog.

For warranty service, contact a Fluke Technical Center or send the product, with a description of the difficulty, postage prepaid, to the nearest Fluke Technical Center. Fluke assumes no risk for damage in transit. Fluke will, at its option, repair or replace the product free of charge. However, if Fluke determines that the failure was caused by misuse, alteration or abnormal condition of operation or handling, you will be billed for the repair. The repaired instrument will be returned to you, transportation prepaid.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE. FLUKE WILL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSS WHETHER IN CONTRACT, TORT, OR OTHERWISE.

Terms & Conditions of Sale

Prices and Terms

Prices shown in this catalog are suggested U.S. list prices prevailing at the time of printing. John Fluke Mfg. Co., Inc. reserves the right to change prices, and the prices in effect at the time an order is received will apply. Prices are F.O.B. origin unless otherwise specified, and apply only when the final destination is within the U.S.A..

U.S. terms are 30 days net. Unless credit has already been established, shipments will be made C.O.D. or on receipt of cash in advance. Terms for orders for other countries are either an irrevocable letter of credit or cash in advance, unless other terms have been previously arranged.

Shipping Methods

Unless specifically requested otherwise, surface transportation is used in the U.S., which may include motor freight or United Parcel Service. Air freight or air express will be used only if you specify it on your order. Unless buyer requests collect shipment, all shipping charges are prepaid and added to the invoice as a separate line item.

Shipments to destinations outside the U.S. are made from the appropriate Fluke or Philips facility by either surface or air, per buyers request. Please note that shipments by sea usually require commercial export packaging at a nominal extra charge.

Product Changes

Although product information and illustrations in this catalog were current at the time it was approved for printing, John Fluke Mfg. Co., Inc., in a continuing effort to offer excellent products at a fair value, reserves the right to change specifications, designs, and models without notice.

Calibration Reports

Special calibration reports are available for a modest fee that include numerical values pertaining to the calibration, the uncertainties associated with the calibration, and statements explaining the calibration. Your local Fluke Sales Office can advise you of the fee for any special calibration report you may require. They must be thoroughly defined when an order is placed.

Power Cords

Power Cords

Fluke instruments are fitted with one of the power cord and plug options shown below and are wired for the voltage indicated. The power cord supplied with your instrument is the one commonly used in the country where the instrument will be delivered.

If you require a power cord and plug other than the one listed below for the country where the instrument will be delivered, specify that power cord and plug when you order.

Philips instruments listed in this catalog are configured for standard North American power requirements. If you require a different configuration, specify power cord and plug combination from the list below.

Environmental Capabilities

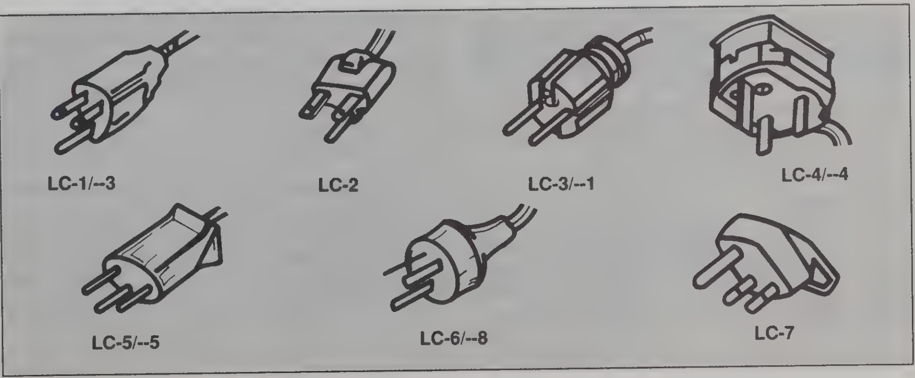
N.B.:

The environmental data is valid only if the instrument is checked in accordance with the official checking procedure. Details of these procedures and failure criteria are supplied on request by your local Fluke or Philips organization.

		Fluke	Philips	
			Product Category 1*	Product Category 2**
North America	120V/15A	Option LC-1	/--3	
North American	240V/15A	Option LC-2		
Universal Euro	220V/16A	Option LC-3	/--1	Specify Country of destination on order
United Kingdom	240V/13A	Option LC-4	/--4	
Switzerland	220V/10A	Option LC-5	/--5	
Australia	240V/10A	Option LC-6	/--8	
South African	240V/5A	Option LC-7	Ask for LC-7	

**Final digit in model number format PM ----/--- for Philips Category 1 Products including Oscilloscopes (except as in 2 below), Multimeters, Recorders, and System 21*

***Philips Category 2 Products including Logic Analyzers, Signal Sources, Pulse Generators, Pattern Generators, Counters and Scope models PM 3219/3264/3266/3267*



Ordering Information

Government Operations Group

Fluke sales offices (see page 504) and the Government Operations offices listed here have the latest information on provisioning, nomenclature, and National Stock Numbers.

National Office
Defense and Government
Operations Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Air Force Offices
Air Force Manager
10417 Gulfdale
San Antonio, TX 78216
(512) 340-2621

5450 Far Hills Avenue
Suite 111
Kettering, OH 45429
(513) 436-2224

Navy Offices
Navy Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

16969 Von Karman Ave.
Suite 100
Irvine, CA 92714
(714) 863-9031

Army Office
Army Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

4920 Corporate Drive
Suite J
Huntsville, AL 35805-6202
(205) 837-0581

Marine Corp Office
Marine Corp Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Dept. of Transportation
(FAA/U.S. Coast Guard)
Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Security Agencies Office
Security Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

U.S. General Services Administration

Most of the instruments in this catalog are available on the following General Services Administration Contracts in FSC Group 66, Part II, Sections "H" and "J", Class 6625:

Contract	Period	Category
GS00F03546 (Section H)	Sept 12, 1988 to July 31, 1991	Electrical/ Electronic Components & Test Equipment
GS00F93525 (Section J)	Sept 28, 1987 to May 31, 1990	Instruments: Measuring and Testing

Special Products, Systems & Services

Listed below are examples of products, systems, and services that specifically support Government applications.

Products

Model 6060A/AN Synthesized Signal Generator. (NSN 6625-01-222-5007). A low-cost efficient signal generator and FM deviation meter with a frequency range of 10 kHz to 520 MHz.

Model 8520A/AS-1 System Multimeter (NSN 6625-01-141-8057). Certified by the Air Force as the first module to complete all requirements imposed by the Modular Automated Test Equipment (MATE) Program.

Model 8025B Multimeter (NSN 6625-01-266-3494). A feature loaded handheld multimeter designed to the rugged requirements of MIL-T-28800 Type II, Class 2, Style A. Basic dc accuracy is 0.1% and includes a 31-segment bargraph for peaking, nulling and capacitor checking, "Touch Hold" to capture and display readings. Operates over the rugged temperature range of -40 to 55°C and comes with a ruggedized hard case and low temperature test leads.

Model 27/FM Multimeter (AN/PSM-45A NSN 6625-01-265-6000). A 3-1/2 digit multimeter with 80K-6 High Voltage Probe selected by the Army as the preferred portable multimeter for multiservice maintenance and repair testing.

Model 8840A/AF Digital Multimeter (NSN 6625-01-196-0014). A low-cost, high-accuracy 5-1/2 digit multimeter for bench and system applications.

9010A/AF Microprocessor Board Test-Set. A bench top "Troubleshooter" for the repair of Microprocessor based equipment and instruments. The Test Set consists of a 9XXXA Digital-System mainframe with a compliment of Test Interface Pods. Selected for use in Calibration and Repair facilities.

Systems

MECCA (Modularly Equipped and Configured Calibrators and Analyzers). Provides the Navy with automatic calibration capability onsite under rigorous conditions by integrating the Fluke 1722A/AP Instrument Controller, 5102B Meter Calibrator and 8506A/AN Digital Multimeter.

Model A123 Automated Calibration System. A high accuracy mobile calibration system, configured to calibrate 5-1/2 and 6-1/2 digit DMMs automatically.

Software

FlexSys (ATLAS Test Software). FlexSys is a complete ATLAS software system which runs on Fluke's powerful IEEE-488 Controller, the 1722A. With FlexSys and the use of resource descriptions, TPS integration is rapid and easy. ATE system reconfiguration can be accomplished without recompiling or modifying ATLAS test procedures.

Services

Direct Voltage Maintenance Program. (See page 231.)

Application Training. Some of the courses presently available, including several which are complimentary with a system purchase, are identified below. Contact your local Fluke sales office or Government Operations field office for the most current information on course/seminar content and attendance considerations. (See page 476.)

1722/1752 Data Acquisition Training Course
2280 Data Loggers Training Course
2452MCS Measurement and Control System
  Training Course
3040A-1 Digital/Analog Board Test System
  Training Course
3050B Digital/Analog Board Test System
  Training Course
3200A Manufacturing Defect Analyzer
  Training Course
6070A/6071A Signal Generator RF Seminar
7405A/7410A-100 Automated Calibration
  System Intermediate Training
9000A Micro-System Troubleshooter
  Introductory Training
  (Basic and Advanced courses)
9100A Programming Courses
Principles of Metrology

Maintenance Training. Fluke understands the needs of customers who want their own maintenance capability, especially the Military. Maintenance training courses currently scheduled for presentation at various Technical Service Centers include: (See page 476 for complete course listing and contact locations.)

1722 Instrument Controller
2280 Data Logger
2452 Intelligent Computer Front End
3040 PCB Test System
3050 PCB Functional Test System
3200 Manufacturing Defects Analyzer
5100/5101/5102 Meter Calibrator
5200 Programmable AC Calibrator
8500/8502/8505/8506 Digital Multimeters
8840 Digital Multimeters
Digital Multimeters (Bench & Handheld models)

Logistics Data Book

The Fluke Government Operations Group has prepared a Logistics Data Book, containing information to aid in ordering Fluke and Philips instruments. The available Fluke and Philips instruments are listed by National Stock Number and cross referenced. Many services available through our Customer Support Group are listed, including replacement spare parts kits, application and maintenance training, and special applications support. To obtain a copy of the Logistics Data Book, please contact the nearest Fluke sales office.

National Stock Numbers

To obtain current NSNs for Fluke and Philips products, turn to the specific product page, the NSNs are printed within the instrument photo. Updated NSN listings are available through the nearest Fluke Government Operations Office or the Logistics Data Book.

Algeria

Bureau de Liaison Philips
(For Fluke and Philips products)
24 rue Bougainville
El Mouradis, Alger
Tel: 60 14 05
TLX: 62221

Antilles

Philips Antillana N.V.
(For Philips products)
Schottegatweg Oost 146
P.O. Box 3523
Willemstad, Curacao
Tel: 599-9-615277
TLX: 1047

Argentina

Coasin S.A.
(For Fluke products)
Virrey del Pino 4071DPTO E-65
1430 CAP FED
Buenos Aires, Argentina
Tel: (54) (1) 552-5248
TLX: (390) 22284

Philips Argentina S.A.
(For Philips products)
Casilla Correo 3479
Vedia 3892
1430 Buenos Aires
Tel: 54-1-5414106/5417141
TLX: 21359/21243

Australia

Philips Scientific & Industrial Pty Ltd.
(For Fluke and Philips products)
Centrecourt 25-27 Paul Street
North Ryde
Sydney N.S.W. 2113
Tel: (61) 88 88 222
FAX: (61) 2-888-0440

Austria

Osterreichische Philips Industrie GmbH
(For Fluke and Philips products)
Geschaftsbereich I & E
Marktbereich Test-und MeBgerate
A-1101 WIEN, Triester StraBe 64
Tel: (0222) 60101/1722 DW

Bangladesh

Motherland Corporation
(For Fluke products)
24 Hatkhola Road, Tikatuli
Dacca-3, Bangledesh
Tel: 257249
TLX: (950) 642022

Philips Bangladesh Ltd.
(For Philips products)
P.O. Box 62, Ramna
16/17 Kawran Bazar C/A
DHAKA
Tel: 411976
TLX: 65668

Belgium

N.V. Philips Professional Systems S.A.
Test and Measurement
(For Fluke and Philips products)
Tweestationsstraat 80
Rue des Deux Gares
Brussel 1070 Bruxelles
Tel: 2-5256111

Bolivia

Coasin Bolivia S.R.L.
(For Fluke products)
Casilla 7295
La Paz, Bolivia
Tel: (591) (2) 40962
TLX: (336) 3233 COALAP BV

Brazil

ATP Hi-Tek Eletronica Ltda.
(For Fluke products)
Al. Amazonas 422, Alphaville
Barueri 06400
Sao Paulo, Brazil
Tel: (55) (11) 421-5477
TLX: (391) 1171413

Philips do Brasil Ltda.
(For Philips products)
Av. Eng. Luiz Carlos Berrini 3009
Caixa Postal 8681
04571 SAO PAULO S.P.
Tel: 55-11-2411611
TLX: (011) 32750

Brunei

Rank O'Connor's, Sdn Bhd
(For Fluke products)
No. 8 Block D,
Sufri Shophouse Complex
Mile 1 Jalan Tutong
Bandar Seri Begawan
Negara Brunei Darussalam
Tel: (673) (2) 23109 or 23557
TLX: (799) BU2265 RANKOC

Canada

Fluke Electronics Canada Inc.
(For Fluke and Philips products)
400 Britannia Rd. East Unit #1
Mississauga, Ontario
L4Z 1X9 Canada
Tel: (416) 890-7600
FAX: (416) 890-6866

Fluke Electronics Canada Inc.
(For Fluke and Philips products)
1690 Woodward Drive
Suite 216
Ottawa, Ontario
K2C 3R8 Canada
Tel: (613) 723-9453
FAX: (613) 723-9458

Fluke Electronics Canada Inc.
(For Fluke and Philips products)
1255 Trans Canada Highway
Suite 130
Dorval, Quebec
H9P 2V4 Canada
Tel: (514) 685-0022
FAX: (514) 685-0039

Fluke Electronics Canada Inc.
(For Fluke and Philips products)
101, 1144 - 29th Ave. N.E.
Calgary, Alberta
T2E 7P1 Canada
Tel: (403) 291-5215
FAX: (403) 291-5219

Chile

Intronica Chile, Ltda.
(For Fluke products)
Casilla 16228
Santiago 9, Chile
Tel: (56) 2-2321886
TLX: (332) 346351

Philips Chilena S.A. de Produc. Electr.
(For Philips products)
Avenida Santa Maria 0760
Casilla 2687
Santiago De Chile
Tel: 56-2-770038
TLX: 240239

Fluke Asia Ltd.
(For Fluke products)
Shun Tak Centre
Suite No. 1501
200 Connaught Road
Central, Hong Kong
Tel: (852) 5-482116
TLX: (780) 87058 Fluke
FAX: (852) 5-479863

Colombia

Sistemas E Instrumentation, Ltda.
(For Fluke products)
Carrera 21, No. 39A - 21, Of. 101
Ap. Aereo 29583
Bogota, Colombia
Tel: (57) 232-4532
TLX: (396) 45787

Industrias Philips de Colombia S.A.
(For Philips products)
Apartado Aereo 4282
Calle 13 No. 51-39
Bogota
Tel: 57-1-2600600
TLX: Philcolon 44776

Denmark

Philips A/S Test & Measurement
(For Fluke and Philips products)
Prags Boulevard 80
DK-2300-Kobenhavn S
Tel: (01) 572222
TLX: 31201

Ecuador

Proteco Coasin Cia., Ltda.
(For Fluke products)
P.O. Box 228-A
Ave. 12 de Octubre 2285 y Orellana
Quito, Ecuador
Tel: (593) (2) 529684
TLX: (393) 22085

Proteco Coasin Cia., Ltda.
(For Fluke products)
P.O. Box 9733
Ave. Principal No. 204 y Calle Segunda
Urbanizacion Miraflores
Guayaquil, Ecuador
Tel: (593) (4) 387519

Philips Ecuador S.A.
(For Philips products)
Casilla 343
Paez 118 y Avenida Patria
Quito
Tel: 593-2-546100/546125
TLX: 2227 PHLPSQ ED

Egypt

Philips Egypt Liaison Office of Philips Export B.V.
(For Fluke and Philips products)
10, Abdel Rahman el Rafei Str.
P.O. Box 1687
Dokki, Cairo
Tel: 20-2-3490922
TLX: 228 16 PHEGY UN

Ethiopia

Philips Ethiopia (Priv. Ltd. Co.)
(For Fluke and Philips products)
Ras Abebe Areguay Avenue
P.O. Box 2565
Addis Ababa
Tel: 148300

Fiji

Awa New Zealand Ltd.
(For Fluke products)
37 Freestone Walu Bay Road
P.O. Box 858
Suva, Fiji
Tel: (679) 312079
TLX: (792) 2347
FAX: (679) 314379

Finland

OY Philips AB
(For Philips products)
P.O. Box 11
02631 ESPOO
Tel: 0-5257225

Instrumentarium Elektronikka
(For Fluke products)
P.O. Box 64
02631 Espoo 63
Finland
Tel: (358) (0) 5281
TLX: (857) 124426
FAX: (358) 0-502-1073

International Sales Offices

France
S.A. Philips Industrielle et Commercials
Division Science de Industrie
(For Fluke and Philips products)
105 rue de Paris, BP 62
93002 BOBIGNY Cedex
Tel: (1) 49 42 80 80
TLX: 210290

Germany
Philips GmbH
(For Fluke and Philips products)
Unternehmensbereich
Elektronik fur Wissenschaft
und Industria
Vertriebsbereich Testr & MeBtechnik
MiramstraBe 87 Postfach 310320
D-3500 KASSEL
Tel: (0561) 5010
TLX: 997070

Bereich Fluke Produkts
Oskar-Messter-Strape 18
D-8045 Ismaning

Great Britain
Philips Test & Measurement
(For Fluke and Philips products)
Colonial Way
Watford WD2 4TT

Greece
Philips S.A. Hellenique
I&E Division
(For Fluke and Philips products)
15, 25th March Street
GR-17778 TAVROS or
P.O. Box 3153 Athens
Tel: 30-1-4894911
TLX: 241566-241567

Hong Kong
Schmidt & Co (H.K.), Ltd
(For Fluke products)
18th Floor, Great Eagle Centre
23 Harbour Road
Wanchai, Hong Kong
Tel: (852) (5) 8330-222
TLX: (780) 74766 or 76762
FAX: (852) 5-8918754

Philips Hong Kong Ltd.
(For Philips products)
29/F Hopewell Centre
17 Kennedy Road
G.P.O. Box 2108
Hong Kong
Tel: 852-5-283298
TLX: 73660 PHILH HX

India
Hinditron Services Pvt., Ltd.
(For Fluke products)
69/A.L. Jagmohandas Marg
Bombay 400 006, India
Tel: (91) (22) 8121316,
(91) (22) 8125344
TLX: (953) 1175326
FAX: (91) 22-822-0197

Hinditron Services Pvt., Ltd.
(For Fluke products)
8th Main Road
33/44A Raj Mahal Vilas Extension
Bangalore 560 080, India
Tel: (91) 812-363139
TLX: (953) 8452741

Hinditron Services Pvt., Ltd.
(For Fluke products)
5th Floor, "Castle House"
5/1A, Hungerford St.
Calcutta 700 017, India
Tel: (91) 33-432628
TLX: (953) 21-4153

Hinditron Services Pvt., Ltd.
(For Fluke products)
204-5-6 Hemkunt Tower
98 Nehru Place
New Delhi, 110019, India
Tel: (91) 11-6410380
TLX: (953) 316458

Hinditron Services Pvt., Ltd.
(For Fluke products)
Emerald Complex 1-7-264
5th Floor
114 Sarojini Devi Rd.
Secunderabad 500 003, India
Tel: (91) 842 821117
TLX: (953) 04256973

Peico Eclectronics & Electricals Ltd.
(For Philips products)
Shivsagar Estate, Block 'A'
Dr. Annie Besant Road
P.O.B. 6598
Worli, Bombay 4000018
Tel: 4921500/4921513

Indonesia
P.T. Lamda Triguna
(For Fluke products)
P.O. Box 6/JATJG, Jakarta 13001
Tel: (62) 21-8195365
TLX: (796) 63938
FAX: (62) 21-819-9631

P.T. Daeng Brothers
(For Philips products)
Centre Point Building, 3rd Fl.
Jalan Gatot Subroto Kav. 35/36
P.O. Box 41 Tebet
Jakarta
Tel: 62-21-517900
TLX: 62798 PHDG IA

Iran
Philips Iran Ltd.
(For Fluke and Philips products)
(Private Joint Stock Comp.)
P.O. Box 11365-3891
Tehran
Tel: 98-21-674138
TLX: 212545 PHPS IR

Iraq
Philips Medden Oosten B.V.
(For Fluke and Philips products)
Baghdad Branch
Hai Al Whida. Area No. 902
Street No. 12, Bldg. 141/10
P.O. Box 5749
Baghdad
Tel: 7187181
TLX: 212439 Philips IK

Ireland
P.J. Brennan and Company Ltd.
(For Fluke and Philips products)
61 Stillorgan Industrial Park
Stillorgan, Co. Dublin
Tel: 952501
TLX: 3817
FAX: 952333

Israel
R.D.T. Electronics Engineering Ltd.
(For Fluke and Philips products)
P.O. Box 43137
Tel Aviv 61430
Israel
Tel: (972) (3) 483211
TLX: 371452
FAX: 972-3-492190

Italy
Philips S.p.A.
(For Fluke and Philips products)
Sezione S & I, T & M Dept.
Viale Elvezia 2
20052 Monza
Tel: (039) 3635240/8/9
TLX: 333343

Japan
John Fluke Mfg. Co., Inc.
Japan Branch
(For Fluke products)
Sumitomo Higashi Shinbashi Bldg.
1-1-11 Hamamatsucho
Minato-ku, Tokyo 105, Japan
Tel: (81) (3) 434-0181
TLX: (781) 2424331
FAX: 81-3-434-0170

John Fluke Mfg. Co., Inc.
Japan Branch
(For Fluke products)
Katsushige Building
2-45 Kohraibashi
Higashi-ku, Osaka 541
Japan
Tel: (81) (6) 229-0871
FAX: 81-6-229-1098

NF Circuit Design Block Co., Ltd.
(For Philips products)
3-20 Tsunashima Higashi, 6-Chome,
Kokokuku, Yokohama 223
Tel: (045) 452-0411
TLX: 3823-297

Kenya
Philips (Kenya) Ltd.
(For Fluke and Philips products)
OL Kalou Road, Industrial Area
P.O. Box 30554
Nairobi
Tel: 254-2-557999
TLX: 22225 Nairobi

Korea, Republic of
Myoung Corporation
(For Fluke products)
Yeo Eui Do
P.O. Box 14
Seoul, Korea
Tel: (82) (2) 784-9942
TLX: (787) MYOUNG K24283
FAX: (82) 2-784-2387

Philips Industries (Korea) Ltd.
(For Philips products)
C.P.O. Box 3680, Philips House
260-199, Itaewon-Dong
Yongsan-Ku
Seoul
Tel: 82-2-794-5011/5
TLX: Philkor K 27291

Kuwait
Al Bahar International Group
(For Fluke products)
P.O. Box 26672 Safat
13127 Safat, Kuwait
Tel: (965) 848601
TLX: (959) 44822

Lebanon
Philips Middle East S.A.R.L.
(For Fluke and Philips products)
B.P. 11-670
Ave. Sami Solh
Beyrouth
Tel: 392320/1
TLX: 20765 LE PHIBAN

Malaysia
Mecomb Malaysia SDN BHD
(For Fluke products)
P.O. Box 24
46700 Petaling Jaya
Selangor, Malaysia
Tel: (60) 3-7743422
TLX: (784) MA37764
FAX: (60) 3-774 3414

Philips Malaysia Snd. Bhd./
Wisma Philips
(For Philips products)
1st, 2nd, 3rd Floors, 3 Jalan
SS 15/2a, P.O. Box 12163
Subang Jaya
47500 Petaling Jaya
Tel: 60-3-7345511
TLX: PHIMAL MA 25111

Mexico

Mexicana de Electronica
Industrial S.A. (MEXEL)
(For Fluke and Philips products)
Diagonal No. 27
Entre Calle de Eugenia Y Ave.
Colonia del Valle
C.P. 03100, Mexico
Tel: (905) 660-4323
TLX: (383) 1771038
FAX: 525-687-8695

Morocco

Somaciel
(For Fluke and Philips products)
304 Boulevard Mohamed V,
Casablanca 05
Tel: 30 80 51/52
TLX: 27021

Nepal

Associated Enterprises
(For Fluke products)
GPO Box 790, Pyaphal Tole
Kathmandu, Nepal
Tel: 13868
TLX: (947) 2568

Netherlands

Philips Nederland
(For Fluke and Philips products)
Philips I&E Systems Div.
Building TQIII-4
5600 MD Eindhoven
The Netherlands
Tel: (31) 40-786839
TLX: (844) 35000 PHTC NL
FAX: (31) 40-785968

New Zealand

Philips Scientific & Industrial
Pty Ltd.
(For Fluke and Philips products)
2 Wagener Place, P.O. Box 4 021
Auckland 3, New Zealand
Tel: (64) (09) 894-160
TLX: NZ 2395
FAX: (64) (9) 862-728

Nigeria

Associated Electronic Products
(Nigeria) Ltd.
(For Fluke and Philips products)
KM 16, Ikorodu Road, Ojota
P.O. Box 1921
Lagos
Tel: 234-1-900160/69
TLX: 21961 NG

Norway

Morgenstierne & Co A/S
(For Fluke products)
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel: (47) (2) 356110
TLX: (856) 71719
FAX: (47) 2-381457

Norsk Al/S Philips

(For Philips products)
Dept. I&E, Test & Measurement
Sandstuveien 70, P.O. Box 1
Manglerud
Oslo 6
Tel: 2-680200

Pakistan

International Operations
(PAK Private), Ltd.
(For Fluke products)
505 Muhammadi House
I.I. Chundrigar Road
P.O. Box 5323, Karachi, Pakistan
Tel: (92) (21) 221127
TLX: (952) 24494

Philips Electrical Co. of Pakistan Ltd.
(For Philips products)
P.O. Box 7101
M.A. Jinnah Road
Karachi 3
Tel: 92-21-725772
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Philips Electric (Pvt.) Ltd.
(For Philips products)
P.O. Box 994
62 Mutare Rd
Harare, Zimbabwe
Tel: 47211

For Philips Service Locations not shown above
Nederlandse Philips Bedrejven B.V.
Service I & E Export
(For Philips products)
Building HBS
5600 MD Eindhoven
The Netherlands
Tel: 31 40 755767

Authorized Distributors

The following products are available from the distributors listed below. To obtain one of these products call the distributor nearest you.

- 21/23/25/27 Handheld Multimeters
- 73/75/77 Handheld Multimeters
- 83/85/87 Handheld Multimeters
- 8020B/8021B/8024B/8026B Handheld Multimeters
- 8060A/8062A Handheld Multimeters
- 1900A/1910A/1911A/1912A Counters
- 37/8010A/8012A/8050A Bench Multimeters
- 51/52/2160A/2170A Series Thermometers
- DMM Accessories

Alabama

Birmingham
(205) 322-3374 BRO
(205) 822-1326 TTE
Huntsville
(205) 883-6530 BNC
Mobile
(205) 479-8581 BRO
(205) 344-0450 SPD
Muscle Shoals
(205) 383-1241 JON

Alaska

Anchorage
(907) 563-3774 ALA

Arizona

Phoenix
(602) 275-2626 DAL
(602) 277-7281 EPC
(602) 437-1425 CRM
(602) 273-7376 STS
Tempe
(602) 431-0880 CRM
Tucson
(602) 889-5301 DAL

Arkansas

Fort Smith
(501) 646-8201 CAB
Little Rock
(501) 376-7044 BLU
(501) 562-2061 BRO
(501) 562-2534 BRW
(501) 562-9100 CAB
(501) 562-7510 IES
Springdale
(501) 756-5012 CAB

California

Anaheim
(714) 978-6363 WAS
Canoga Park
(818) 998-6500 RAG
(818) 998-7652 STS
Chatsworth
(818) 700-0900 ITC
(818) 407-0101 MAR
Commerce
(213) 685-4340 CRM
El Monte
(818) 459-5500 MAR
El Segundo
(213) 772-8170 TMT
(213) 772-8171 WAS
Fremont
(415) 770-0590 ALE
(415) 651-6720 GEO
Fullerton
(714) 773-9555 SPE
Gardena
(213) 770-2330 CSS
Inglewood
(213) 674-9249 HUR
Irvine
(714) 859-0211 MAR
Laguna Hills
(714) 582-9180 ISI
Los Angeles
(213) 685-7020 EIL
(213) 724-2222 GIS
(213) 388-0621 ITC
Milpitas
(408) 943-4700 MAR
(408) 942-5432 ZAC
North Hollywood
(213) 877-5518 BJW
Oakland
(415) 834-5888 BRI
Oxnard
(805) 983-4115 ITC
Palo Alto
(415) 960-8500 CRM
Rancho Cordova
(916) 635-9700 MAR
Sacramento
(916) 446-3131 ZAC
San Bernardino
(714) 885-0721 HUR
San Diego
(619) 578-9606 MAR
(619) 560-4841 CRM
(619) 578-2102 WAS
San Francisco
(415) 626-1444 ZAC
San Jose
(408) 998-5900 QUE
San Marcos
(619) 744-2690 MIT
San Mateo
(415) 572-6600 USI
Santa Ana
(714) 971-2992 HUR
Santa Clara
(408) 727-2500 WYL
Sunnyvale
(408) 734-9660 CMK
(408) 245-4320 EIL
(408) 745-6020 TKS
Vallejo
(707) 644-6676 ZAC
Van Nuys
(818) 781-8410 HUR
Yorba Linda
(714) 921-2101 CRM

Colorado

Aurora
(303) 340-8728 RRI
Colorado Springs
(719) 636-1661 COL
Denver
(303) 832-1111 CWE
(303) 534-4160 EIL
Englewood
(303) 762-0670 SHR

Connecticut

Greenwich
(203) 531-4880 WIS
Hartford
(203) 527-1881 HAT
Middletown
(203) 346-6646 EIL
New Haven
(203) 787-5921 HAT
Stratford
(203) 375-5866 HAT
Wallingford
(203) 265-9333 CEI
Waterbury
(203) 755-1181 HAT

Delaware

Wilmington
(302) 656-3222 WHO

District of Columbia

Washington
(202) 529-6020 WSJ

Florida

Ft. Lauderdale
(305) 563-4131 SEE
Jacksonville
(904) 356-4851 EMS
Melborne
(407) 242-8151 ROM
Miami
(305) 884-3072 BRO
(305) 871-3500 EEC
Orlando
(305) 843-6770 BRO
(305) 849-6060 EMS
Palm Bay
(407) 725-8300 EIL
Pompano Beach
(305) 978-3008 AEL
Tampa
(813) 253-0104 EMS
(813) 870-3315 SPD
West Palm Beach
(407) 659-7166 DOL

Georgia

Albany
(912) 435-1711 SPD
Athens
(404) 548-1334 SPD
Atlanta
(404) 762-5181 BRO
(404) 325-0759 TEI
Augusta
(404) 722-2055 DIX
(404) 722-1526 SPD
Brunswick
(912) 265-1927 SPD
Columbus
(404) 327-7414 SPD
Kennesaw
(404) 425-8902 CRM
Norcross
(404) 447-8431 WIE
(404) 377-3555 ALE
(404) 448-4004 SPD
Savannah
(912) 234-1684 SPD

Hawaii

Honolulu
(808) 533-3884 ELE
(808) 949-5564 HON

Idaho

Boise City
(208) 336-2227 RAD
Twin Falls
(208) 733-5636 IDA

Illinois

Bridgeview
(312) 430-2292 EIL
Champaign
(217) 356-1896 KLA
Countryside
(312) 352-3500 PIC
Downers Grove
(312) 964-2440 ASC
Elgin
(312) 697-8200 ALE
Glendale Heights
(312) 351-4554 CRM
Inverness
(312) 991-9770 USI
LaSalle
(815) 223-7400 KLA
Niles
(312) 297-4200 JOS
Peoria
(309) 691-4840 KLA
Quincy
(217) 223-7560 KLA

Rockford
(815) 962-8036 MIA
Rolling Meadows
(312) 394-5441 COM
Schaumburg
(312) 490-0755 MAR

Indiana

East Chicago
(219) 397-8681 ACO
Indianapolis
(317) 634-8202 BEL
(317) 635-3511 MEU
(317) 849-7300 PIN

Iowa

Eldridge
(319) 285-8484 KLA

Kansas

Industrial Airport
(913) 791-7000 NOR
Kansas City
(913) 384-2064 PMC
Lenexa
(913) 492-0500 PIN

Kentucky

Louisville
(502) 637-7674 PEE

Louisiana

Alexandria
(318) 433-4517 RAL
Baton Rouge
(504) 272-4420 BRG
(504) 357-4249 IES
(504) 344-8114 RAL
Harahan
(504) 734-8888 BUT
Kenner
(504) 466-3401 BRG
Lafayette
(318) 234-1405 BRG
(318) 233-0105 RAL
Morgan City
(504) 383-9831 RAL
New Iberia
(318) 369-9816 RAL
New Orleans
(504) 733-8355 IIW
(504) 525-8222 WBA
Shreveport
(318) 636-9975 CAB
(318) 222-9459 IES

Maine

See Massachusetts

Maryland

Gaithersburg
(301) 840-9450 MAR
Rockville
(301) 881-2270 CAP
Sparks
(301) 771-4800 EIL

Massachusetts

Burlington
(617) 272-9450 EIL
Cambridge
(617) 491-5500 KAU
Marlboro
(508) 481-6638 SPE
North Andover
(508) 682-2000 CEI
N. Billerica
(508) 667-8541 ELT
Natick
(617) 237-1134 CAL
Wilmington
(617) 942-0150 ALE
(617) 658-0810 MAR
Woburn
(617) 935-7820 BRO

Michigan

Flint
(313) 743-8940 SHD
Grand Rapids
(616) 698-1800 PIN
(616) 241-3483 RSE
Livonia
(313) 525-1155 RSE

Minnesota

Burnsville
(612) 894-6154 ATR
Minneapolis
(612) 544-8916 INS
(612) 544-4035 PMC
(612) 332-1325 STA
Plymouth
(612) 559-2255 MAR
St. Paul
(612) 483-3322 GOE
(612) 642-2828 SHR

Mississippi

Columbus
(601) 328-6212 BLU
Tupelo
(601) 842-6832 BLU

Missouri

Kansas City
(816) 931-0250 ESU
(816) 333-6569 ISL
St. Louis
(314) 535-5760 ISL

Montana

See Colorado, Oregon
or Washington

Nebraska

Lincoln
(402) 466-8221 SCO
North Platte
(308) 532-9260 SCO
Omaha
(402) 734-6750 SCO

Nevada

Las Vegas
(702) 733-3888 KIE

New Hampshire

See Massachusetts

New Jersey

Edison
(201) 287-2030 BRO
Mommouth Junction
(201) 494-1500 USI
Paramus
(201) 444-8717 ROU
Pine Brook
(201) 227-1262 PIN
South Hackensack
(201) 488-0008 COD
South Plainfield
(201) 561-1133 TST
Springfield
(201) 379-7710 ROU
Totowa
(201) 256-8555 ROU
West Caldwell
(201) 808-4646 TOO

New Mexico

Albuquerque
(505) 293-6161 EPC

New York

Albany
(518) 438-7811 EET
Brooklynn
(212) 732-8163 HHS
Buchanan
(914) 736-1000 ETC
Clarence
(716) 634-8500 EIL
Corning
(607) 962-0555 COR
Farmingdale
(516) 420-5990 BRO
Great Neck
(516) 487-7430 INM
Hauppauge
(516) 231-6333 EIL
Johnson City
(607) 798-1611 MAR
Long Island City
(718) 361-1100 HLD
Mineola
(516) 248-2360 ALE
New York
(212) 675-7944 NIL
(212) 575-5194 TAF
Plainview
(516) 349-7620 KEL
Rochester
(716) 546-5373 MAE
(716) 235-7620 MAR
(716) 458-4801 TRA
Rome
(315) 337-5400 ROM

North Carolina

Charlotte
(704) 597-1270 BRO
(704) 377-5413 DIX
(704) 376-2237 EIL
Raleigh
(919) 876-6524 BRO
Welcome
(704) 731-6391 WAL

North Dakota

Fargo
(701) 237-5003 SAS

Ohio

Cincinnati
(513) 351-2000 HUG
Cleveland
(216) 651-4100 CRM
(216) 587-3600 PIN
Columbus
(614) 294-5351 HUG
Dayton
(513) 435-2134 EIL
(513) 236-9900 PIN
Maumee
(419) 893-0721 RSE
Warren
(216) 373-1300 REM

Oklahoma

Oklahoma City
(405) 681-4446 CAB
Tulsa
(918) 250-1626 CAB
(918) 627-1500 INO
(918) 254-8606 NEI
(918) 836-0286 TRI

Oregon

Beaverton
(503) 626-6633 CMK
Portland
(503) 232-3404 RAD

Pennsylvania

Allentown
(215) 437-6743 WHO
Braddock
(412) 351-5000 LEF
Montgomeryville
(215) 822-0141 BOM
No. Huntington
(412) 864-7423 REM
Philadelphia
(215) 673-5600 SUN
Plymouth Meeting
(215) 825-4990 TTI
Trevose
(215) 364-2830 BRO

Puerto Rico

Ponce
(809) 843-2260 TRE
Santurce
(809) 725-4765 BON

Rhode Island

Pawtucket
(401) 728-4600 JAB

South Carolina

Charleston
(803) 722-2634 WIE

Columbia
(803) 772-6111 BRO
(803) 779-5332 DIX
(803) 256-0746 WIE
Greenville
(803) 297-1430 DIX
(803) 233-4121 EMS
North Charleston
(803) 554-7515 DIX

South Dakota

See Minnesota or
North Dakota

Tennessee

Gray
(615) 247-7125 DIX
Knoxville
(615) 966-3441 BRO
Memphis
(901) 365-3539 CAB
(901) 345-9500 BLU
(901) 795-8487 BRO
Nashville
(615) 242-8000 BLU
(615) 885-1302 BRO

Texas

Austin
(512) 837-5555 NEI
Beaumont
(409) 833-9443 RAL
(409) 838-0393 RAW
Corpus Christi
(512) 887-0001 RAW
Dallas
(214) 631-3600 BRW
(214) 343-8800 BUT
(214) 243-7000 INO
(214) 233-0020 NEI
(214) 969-9400 WES
El Paso
(915) 778-4448 GIS
(915) 533-9555 MID
Fort Worth
(817) 336-5401 ALE
Freeport
(409) 233-5451 BRW
Garland
(214) 271-5671 CRM
(214) 348-8800 TUK
Houston
(713) 526-3456 ETX
(713) 688-7000 INO
(713) 644-1631 MTI
(713) 777-1666 NEI
(713) 694-2771 BRO
(713) 688-8126 RAW
(713) 955-0595 SPE
Irving
(214) 550-1923 SPE
(214) 659-0930 VWR
Longview
(214) 753-0919 IES
Midland
(915) 694-9657 ESI
Port Lavaca
(512) 552-7525 RAW
Richardson
(214) 234-3392 USI
San Antonio
(512) 491-9460 RAW
Texarkana
(214) 792-6923 CAB
Texas City
(409) 948-3446 RAW
Wichita Falls
(817) 723-8106 WES

Utah

Salt Lake City
(801) 261-8877 EIL
(801) 486-3371 SSC

Vermont

See Massachusetts or
New York

Virginia

Arlington
(703) 524-2412 ARL
Bluefield
(304) 487-1477 BRO
(703) 322-3402 BRO
Norfolk
(804) 855-2400 BRO
(804) 499-3746 EIL
(804) 855-0105 PEL
Richmond
(804) 275-1431 MEM
Springfield
(703) 569-2611 EIL

West Virginia

See Ohio,
Pennsylvania, Maryland
or Virginia

Washington

Redmond
(206) 882-3222 EIL
(206) 823-4111 VAN
Richland
(509) 943-8336 RAD
Seattle
(206) 547-2827 ALE
(206) 762-6050 BIC
(206) 282-2511 RAD
Spokane
(509) 747-3053 RAD

Wisconsin

Green Bay
(414) 435-8331 NRT
Milwaukee
(414) 475-6000 MES
Oshkosh
(414) 235-8930 ELI

Wyoming

See Colorado,
Nebraska, or Utah

ACO	ACRO Electronics, Corp.
ALA	Alaska Electronics Supply
ALE	Allied Electronics
ARL	Arlington Electronic
ASC	Ames Supply Co
ATR	Atrix Tool
BEL	Bell Industries
BIC	Branom Instrument Co.
BJW	B.J. Wolfe
BLU	Bluff City Electronics
BNC	B & C Instruments
BOM	Bomar Electronics
BON	Bonnin Electronics
BRG	Breard-Gardner
BRI	Brill Electronics Products
BRO	Brownell Electro
BRW	Briggs-Weaver
BUT	Butler & Land
CAB	Carlton-Bates
CAL	Calcotron
CAP	Capital Radio
CEI	Contact East Inc.
CMK	Com Kyl
COD	Concord Electronics
COL	Col. Spgs. Wintronic Co.
COM	Commodore I
COR	Corning Electronics
CRM	Crompton Metermaster, Inc.
CSS	California Switch & Signal
CUM	Cumberland Electronics Inc.
CWE	CW Electronic Sales
DAL	Dalis Electronics
DIX	Dixie Electronics
DOL	Dolphin Electronic Supply
EET	E.E. Taylor
EIL	EIL Instruments
ELE	Electrical Equipment Co. Ltd.
ELI	Electronic Industries, Inc.
ELT	Electra-Test
EMS	EMSCO Div. Hammond
EPC	Electronic Parts Co.
ESU	Electronic Supply
ETC	Electronic Tool Co
ETC	Electrotex
GIS	Garrett Industrial Supply
GEO	George Oliver Co.
GOE	Gopher Electronics
HAT	Hatry Electronics
HHS	Herman H. Sticht
HLD	H.L. Dalis, Inc.
HON	Honolulu Electronics
HUG	Hughes-Peters
HUR	Hurley Electronics
IDA	Idaho Instruments
IES	Industrial Electronic Supply
IIW	Industrial Instrument Works
INM	Instrument Mart
INO	INOTEK
INS	Instrumentation Services
ISI	ISI Services, Inc.
ISL	Industrial Service Labs
ITC	ITC Electronics
JAB	Jabbour Electronic Supply
JON	Jones Electronics
JOS	Joseph Electronics
KAS	KASS Electronics Dist.
KAU	Kaufman Co.
KEL	Kelvin Electronics
KIE	Kiesub Corporation
KLA	Klaus Radio
LEF	Leff Electronics
MAE	Masline Electronics Inc.
MAR	Marshall Industries
MEM	Metermetrics
MES	Marsh Electronics
MEU	Meunier Electronic Sply, Inc.
MIA	Mid-West Associated
MID	Midland Winntronics
MIT	Mitchell Instruments Co.
MTI	Meters & Instruments
NEI	Norvell Electronics
NIL	Nilsson Electrical Lab
NOR	North Supply
NRT	Northern Radio & TV
PEL	Priest Electronics
PIC	Pacific Indicator Co.
PIN	Pioneer-Standard
PMC	Process Measurement Co.
PRL	Peerless Elect. Equip
QUE	Quement Electronics
RAD	Radar Electric
RAG	Rag Electronics
RAL	Ralph's Electronics
RAW	Rawson & Co.
REM	REM Electronics
ROM	Rome Electronics
ROU	Route Electronics
RRI	R&R Instrumentation
RSE	RS Electronics
SAS	S&S Electronics
SCO	Scott Electronics
SEE	Southeastern Elect.
SHD	Shand Electronics
SHR	Shelley-Ragon
SPD	Specialty Distributing
SPE	Specialized Products
SSC	Standard Supply Co.
STA	Stark Electronic Supply
STS	Scottsdale Tool & Supply
SUN	Sunshine Scientific
TAF	Taft Electronics
TEI	Techmart Inc.
THA	ThermX of California
THX	ThermX Southwest
TKS	Tool Kit Specialists
TMT	Time Motion Tools, Inc.
TOO	Tool Tronics
TRA	Transcat
TRE	Tech. Representations
TRI	Tri-State Inst. Lab
TST	Test Equipment Service, Inc.
TTE	Technical Training Aids
TTI	Techni-Tool, Inc.
TUK	Tucker Electronics, Co.
USI	U.S. Instrument Rentals
VAN	Vanguard Electronic Tool
VWR	VWR Scientific
WAL	Walker & Associates
WAS	WASSCO
WBA	W.B. Allen Supply
WES	Wholesale Elec. Supply
WHO	Wholesale Electronics
WIE	Wholesale Ind. Elec.
WIS	Wise Components
WSJ	WS Jenks
WYL	Wyle Lab Mkt. Group
ZAC	Zack Electronics

Rental Companies

Continental Resources, Inc.

Nationwide Toll Free
(800) 343-4688

Carson, CA
(213) 638-0454

San Francisco, CA
(408) 263-1775

Orlando, FL
(407) 855-9544

Bensenville, IL
(312) 860-5991

Bedford, MA
(617) 275-0850

Gaithersburg, MD
(301) 948-4310

Somerset, NJ
(201) 654-6900

Dallas, TX
(214) 458-7616

Electro Rent Corp.

Nationwide Toll Free Number
(800) 423-2337
(Except California)

Alabama
(800) 241-9156

Alaska
(415) 964-5500

Arizona
(800) 423-2337

Arkansas
(800) 553-RENT

California
Burbank
(818) 843-3131

Mountain View
(415) 964-5500

San Diego
(619) 571-7905

Southern CA
(800) 232-2173

Northern &
Central CA
(800) 421-4848

Canada
(800) 268-0216

Colorado
(800) 227-8010

Connecticut
(800) 225-0836

Delaware
(800) 638-1783

District of Columbia
(301) 982-1450

Florida
(800) 241-9156

Georgia
(404) 925-9199

Hawaii
(800) 423-2337

Idaho
(800) 227-8010

Illinois
(312) 956-8350

Indiana
Southern
(800) 521-5788

Northern
(800) 323-8893

Iowa
(800) 323-8893

Kansas
(800) 323-8893

Kentucky
(800) 521-5788

Louisiana
(800) 553-RENT

Maine
(800) 225-0836

Maryland
(301) 995-6707

Massachusetts
(508) 657-8400

Michigan
(313) 522-8555

Minnesota
(800) 323-8893

Mississippi
(800) 241-9156

Missouri
(800) 323-8893

Montana
(800) 227-8010

Nebraska
(800) 323-8893

Nevada
(800) 232-2173

New Hampshire
(800) 225-0836

New Jersey
(201) 857-2280

New Mexico
(800) 232-2173

New York
(800) 631-4278

North Carolina
(800) 638-1783

North Dakota
(800) 323-8893

Ohio
(800) 521-5788

Oklahoma
(800) 553-RENT

Oregon
(800) 227-8010

Pennsylvania
Western
(800) 521-5788

Eastern
(800) 631-4278

Rhode Island
(800) 225-0836

South Carolina
(800) 241-9156

South Dakota
(800) 323-8893

Tennessee
(800) 241-9156

Texas
(214) 437-3383
(800) 442-1144

Utah
(800) 227-8010

Vermont
(800) 225-0836

Virginia
(800) 638-1783

Washington
(800) 227-8010

West Virginia
(800) 638-1783

Wisconsin
(800) 323-8893

Wyoming
(800) 227-8010

G.E. Quick Rentals

Compton, CA
(800) GE-RENTS
(213) 605-1290

Norcross, GA
(404) 662-1338

Hammond, IN
(312) 780-0300

Schenectady, NY
(518) 385-5316

Genstar Rental Electronics, Inc.

Palo Alto, CA
(415) 856-7600
(800) 225-2422

Woodland Hills, CA
(818) 887-4000
(800) 331-3440
(800) 227-8409

Orlando, FL
(407) 859-0322
(800) 432-0612
(800) 327-0302

Gaithersburg, MD
(301) 621-4043
(800) 638-4040

Mahwah, NJ
(201) 934-0400
(800) 631-8960
(800) 562-3714

Carrollion, TX
(214) 931-8770
(800) 492-9021
(800) 323-8964

Canada, Ontario
(416) 675-7513
(800) 268-4939

Quebec
(514) 337-5775
(800) 367-5447

Leasametric

Nationwide Toll Free Number
(800) 553-2255

Alabama
(800) 638-9245

Alaska
(Call Collect)
(415) 574-5797

Arizona
(800) 521-4312

Arkansas
(800) 255-9568

California
Foster City
(415) 574-5797

Anaheim
(714) 634-5925

Los Angeles
(213) 671-0461
(818) 708-7334
(800) 824-4299

San Diego
(619) 565-7475

Colorado
(800) 255-9568

Connecticut
(800) 553-2255

Delaware
(800) 553-2255

Florida
(800) 638-9224

Georgia
(800) 638-9245

Hawaii
(Call Collect)
(415) 574-5797

Idaho
(800) 521-4312

Illinois
(800) 553-2255

Indiana
(800) 553-2255

Iowa
(800) 255-9568

Kansas
(800) 255-9568

Kentucky
(800) 638-9245

Louisiana
(800) 255-9568

Maine
(800) 553-2255

Maryland
(301) 948-9700

Massachusetts
(800) 553-2255

Michigan
(800) 553-2255

Minnesota
(800) 255-9568

Mississippi
(800) 255-9568

Missouri
(800) 255-9568

Montana
(Call Collect)
(714) 634-9525

Nebraska
(800) 255-9568

Nevada
Northern
(415) 574-5797

Southern
(800) 521-4312

New Hampshire
(800) 553-2255

New Jersey
(800) 553-2255

New Mexico
(800) 255-9568

New York
(800) 553-2255

North Carolina
(800) 638-9245

North Dakota
(800) 255-9568

Ohio
(800) 553-2255

Oklahoma
(800) 255-9568

Oregon
(800) 343-7368

Pennsylvania
(800) 441-7568

Rhode Island
(800) 553-2255

South Carolina
(800) 638-9245

South Dakota
(800) 255-9568

Tennessee
(800) 638-9245

Texas
Dallas
(214) 881-0279

Houston
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• Product Information • Application Assistance • Warranty Terms & Conditions	Your Fluke Sales Office OR. . .if rush information is needed 800-44-FLUKE	Your Fluke or Philips Sales Office or Representative (See page 493)
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• Maintenance Training • Application Training	800-44-FLUKE, ext. 73	Your Fluke or Philips Sales Office or Representative (See page 493)
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